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Literature Review

Prevalence of childhood overweight and obesity in the Arabian Gulf countries

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1. Abstract

Background: Childhood overweight and obesity has become a major public health problem in the Arabian Gulf countries leading to variety of medical consequences.

Objectives: To investigate the prevalence of overweight and obesity among Arabian Gulf children and adolescents.

Findings: The prevalence of childhood obesity is exceptionally high in the Arabian Gulf region reaching up to 42.4% among Bahraini girls and 36.3% among Qatari boys. A rising trend of prevalence has been reported in all Arabian Gulf countries increasing by up to seven times (3.4% to 24.5%) in Saudi Arabia for example, between 1988 and 2005. Prevalence of overweight and obesity is strongly correlated with age, as it is higher in older children and adolescents compared with younger children. Prevalence data is limited and scarce in some countries such as Oman.

Conclusion: Childhood obesity is high and continues to increase in the Arabian Gulf region. Continued surveillance is needed at a national level, particularly in Oman. This would assist in public health policy making and support prevention and control strategies.

2. Introduction

Obesity is a major health concern in the Middle Eastern countries and has reached alarming rates among both adults and children (Musaiger, 2011). Childhood obesity has been reported to demonstrate high prevalence in the Middle Eastern region (de Onis & Blössner, 2000) particularly in the Arabian Gulf states (El-Ghaziri, Boodai, Young & Reilly, 2011; Al-Dossary, Sarkis, Hassan, Regal & Fouda, 2010). Childhood obesity has become evident and exceptionally high in the Arabian Gulf region (Malik & Bakir, 2007; Kerkadi, Hassan & Yousef, 2009) particularly in the last two decades (Malik & Bakir, 2007 reaching up to 42.4% among Bahraini girls (International Association for the Study of Obesity [IASO], 2012). This suggests a shift in which the wasting and malnutrition which commonly existed in 1980s was replaced by overweight and obesity in this part of the world (de Onis & Blössner, 2000).

Childhood obesity presents major health concerns and is widely recognized as a risk factor for a range of medical and psychological consequences (Al-Isa, 2004; El Mouzan, Al Herbish, Al Salloum, Al Omar & Qurachi, 2012). In the Arabian Gulf, multiple health risks are correlated with overweight and obesity among children and adolescents such as high blood pressure (Al Junaibi, Abdulle, Sabri, Hag-Ali & Nagelkerke, 2013; Taha, Ahmed & bin Sadiq, 2009), metabolic and cardiovascular risk factors (Taha et al., 2009) and type 2 diabetes (Moussa et al., 2008; Punnose, Agarwal, El Khadir, Devadas & Mugamer, 2002). Furthermore, strong evidence (Rolland-Cachera, 2011; Mirmiran, Sherafat-Kazemzadeh, Jalali-Farahani & Azizi, 2010; Nader eta al., 2006) suggests that obese children grow to be obese adults.

This paper aims to review the literature concerning the prevalence of childhood overweight and obesity in the Arabian Gulf states that consist of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE). This will include the definition and classification of childhood obesity, prevalence and secular trends of childhood obesity in the Arabian Gulf and demographic risk factors that are associated with childhood overweight and obesity.

3. Definition and classification of childhood obesity

The definition of childhood obesity is more complex compared to that used for adults (Guillaume, 1999; World Health Organization [WHO], 2000). This is due to the growth factor in children and the puberty period that influences fat accumulation (Guillaume, 1999; Mirmiran et al., 2010) as well as the continued growth in stature (height) among children and adolescents (WHO, 2000).

In general, the term obesity is often defined as an excess body fat that leads to increased risk of ill health and morbidity (WHO, 2000). However, due to difficulties associated with measuring body fat, body mass (weight) is often used to indicate obesity (Ogden & Flegal, 2010).

In addition, definitions and cut-off values that are used to assess and describe overweight and obesity among children and adolescents vary (Ogden & Flegal, 2010). Furthermore, none of them is considered ideal and their use is mostly based upon current practice (Rolland-Cachera, 2011). However, most definitions are similar and are based on body mass index [BMI] (Flegal & Ogden, 2011), as illustrated in Figure (1).

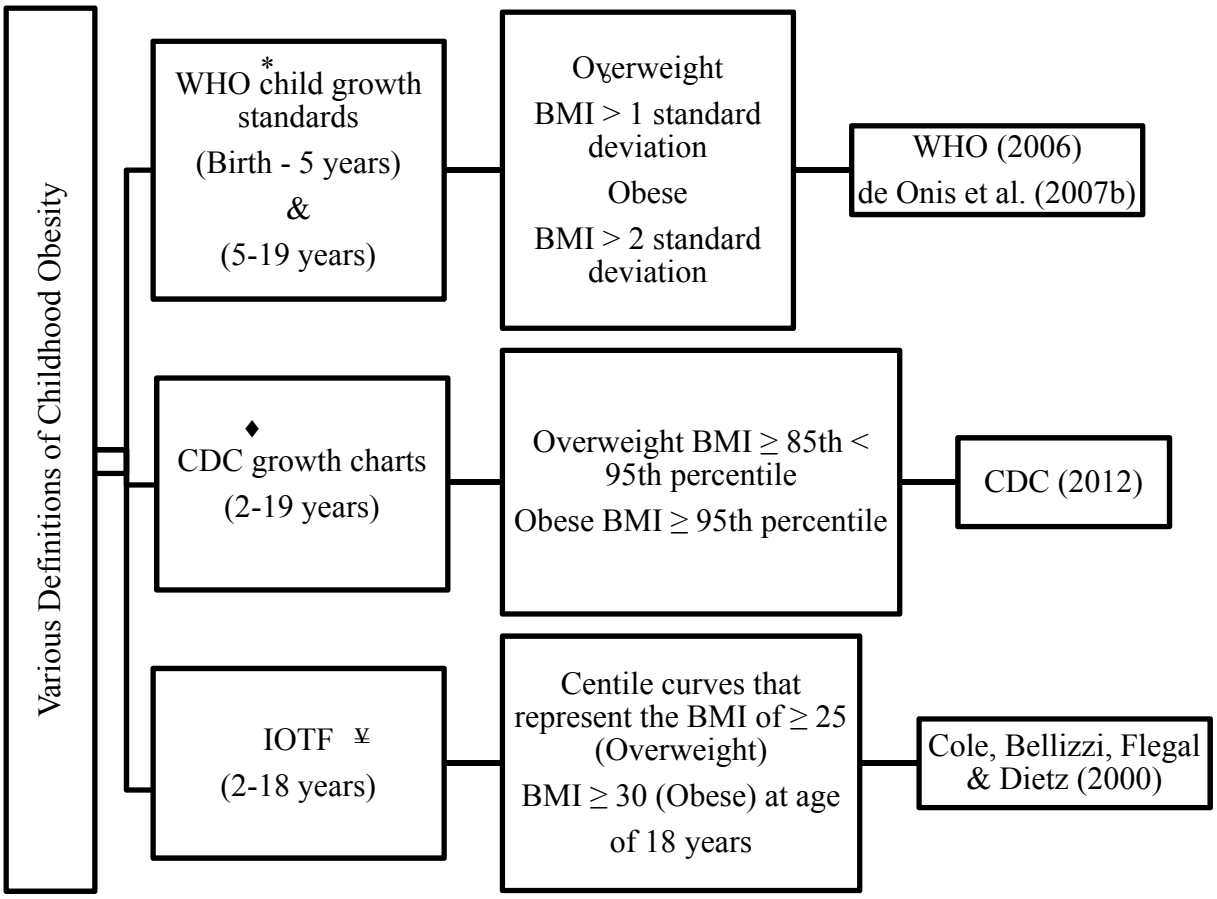

Figure 1: Various Definitions of Childhood Obesity

*WHO= World Health Organization
°BMI= Body Mass Index
♦CDC= Centers for Disease Control
¥ IOTF= International Obesity Task Force

The BMI was validated for use in children in the early 1980s (Rolland-Cachera, 2011). However, unlike in adults, BMI in children is compared by gender and age-specific values to account for variability (Ogden & Flegal, 2010). It is however important to note that BMI is not a diagnostic tool but rather a screening tool. Children above the thresholds do not necessary present any clinical complication or health risk, thus more

in-depth assessment is required for the individual child (Flegal & Ogden, 2011). In addition, BMI usually measures excess body mass, but not necessary excess body fat (Flegal & Ogden, 2011; Rolland-Cachera, 2011; Freedman & Sherry, 2009). Nonetheless, in practice, measuring body fat is difficult in both clinical and epidemiological studies (Flegal & Ogden, 2011).

However, despite some concerns, there is a general agreement on the appropriateness of BMI to define overweight and obesity in children and adolescents (Monasta, Lobstein, Cole, Vignerová & Cattaneo, 2011; Rolland-Cachera, 2011). For example, Reilly (2005) reports that high quality body of evidence based on a systematic review suggests that children with BMI cut-off points ≥85th and ≥ 95th percentile are at higher risk of morbidity compared to their lower BMI counterparts. Similarly, Freedman and Sherry (2009) state that BMI for age ≥ 95th percentile is considered a specific indicator of excess adiposity among children. Therefore, BMI use in paediatrics is fairly accurate and meaningful (Reilly, 2005; Bellizzi & Dietz, 1999) as it has been shown to correlate with adiposity in children (Mandalia, 2012; Al-Isa & Thalib, 2006).

Therefore, it is generally agreed that BMI is suitable for use in public health surveillance as well as clinical applications (El-Ghaziri et al., 2011; Al-Isa & Thalib, 2006). The BMI for age is an important indicator for monitoring the childhood obesity epidemic (de Onis et al., 2012) and is the most simple and practical means for assessing body mass in children and adolescents (El-Ghaziri et al., 2011). However, results must be interpreted cautiously since BMI may be affected by ethnicity due to difference in body compositions (Rolland-Cachera, 2011).

Various definitions of overweight and obesity among children and adolescents are used in research. For example, the IOFT cut-offs are based on percentiles corresponding to predicted BMI 25 kg/m^2 and 30 kg/m^2 at age of 18 years (Cole et al., 2000). However, centiles that define underweight and extreme obesity are not included in IOTF definition nor are infants below 2 years (Chinn, 2006). Nevertheless, the IOTF definition is widely used worldwide, as it has been designed for international descriptive and comparative purposes (Flegal & Ogden, 2011; Al-Sendi, Shetty & Musaiger, 2003b).

In contrast, the WHO growth charts are mostly used for clinical monitoring of growth patterns (Flegal & Ogden, 2011) as well as in research. The WHO standards and references have several advantages since they include children from birth (Rolland-Cachera, 2011) and compare to CDC and IOTF standards. This allows assessment and monitoring of childhood obesity from infancy and early age (El-Mouzan et al., 2010b). In addition, the WHO provides a free to download software that converts anthropometric measurements into standard deviations (Rolland-Cachera, 2011).

The standard deviations or z-scores, are expressed as a number or anthropometric value of standard deviation below or above the reference mean or median value (WHO, 2013b). It has been suggested that including z-scores is useful in clinical settings as it allows tracking of those beyond the percentile range such as severely undernourished or severely obese children (de Onis et al., 2012).

The WHO growth standards have been widely adopted worldwide with 125 countries of which 22 are Eastern Mediterranean Region (EMR) countries reporting implementing the standards into their practice of child growth assessment (de Onis et al., 2012). Of the

countries in EMR 77% (n=17) have adopted the standard and 23% (n=5) remains under consideration (de Onis et al., 2012). However, WHO standard faces same criticism that affects other definitions including the use of BMI as an imperfect measure of adiposity (Flegal & Ogden, 2011).

Nevertheless, in the Arabian Gulf countries, the WHO standards are preferred due to the fact that they are based on breastfed children references which are known to be leaner compared to bottle fed counterparts (Soliman, Eldabbagh, Khalafallah, Alali & Elalaily, 2011). In addition, Soliman et al. (2011) recommend the use of WHO standards over CDC for example since it has an advantage of detecting overweight and obesity early in infancy and consequently facilitates early management and control. Furthermore, El-Mouzan et al. (2010a) suggest that the WHO 2007 reference standards have the potential to become the future reference of choice for the surveillance of overweight and obesity in children.

On the contrary, it has been suggested that in assessing childhood overweight or obesity, considering other factors such as family history as well as using other measurements such as waist circumference (WC) may be useful (Flegal & Ogden, 2011). Waist circumference has proved to be effective for identifying central obesity in children aged 3-19 years when used alongside the dual-energy X-ray absorptiometry [DXA] (Taylor, Jones, Williams & Goulding, 2000). Furthermore, Savva et al. (2000) suggest that waist circumference is a better predictor of cardiovascular diseases risk factors in children than the BMI. In addition, Messiah et al. (2012) found that greater BMI and WC to be related to biomarkers of cardiovascular risk in children and suggested that paediatric health care professionals should consider using both measurements (Messiah et al., 2012).

In clinical settings as well as in epidemiological studies the BMI is considered the most practical, inexpensive and simple method for assessing body mass and obesity (Rolland-Cachera, 2012). Waist circumference is also considered simple and inexpensive (Messiah et al., 2012). However, more sophisticated instruments are available for more accurate measures of total body composition, such as underwater weight (Hydrodensitometry), isotope dilution, total body electrical conductivity and whole body plethysmography (Bray, 2011; WHO, 2000). Nevertheless, the disadvantage of those instruments is that they are limited, not widely available and expensive, require competent technicians, and are time consuming (Bray, 2011; WHO, 2000).

In summary, defining childhood overweight and obesity is complex. There are various definitions and recommended reference cut-offs, however, to date there is no one ideal reference and the decision to use one reference over another is mainly due to practicality. Despite some limitations, BMI remains the basis for defining and classifying childhood overweight and obesity (Reilly, 2005). The BMI is useful for comparisons between groups or population; however, it should be recognized as an indication of overweight rather than excess body fatness (Rolland-Cachera, 2011; Freedman & Sherry, 2009). Including waist circumference in the assessment, together with the BMI should be considered. The next section, aims to evaluate studies that have compared different reference standards for the same database.

4. Research on different childhood obesity international reference standards

Research suggests that using different reference standards such IOFT versus WHO on the same datasets yield different rates (Monasta et al., 2011). The IOTF has been reported to underestimate obesity prevalence compared to CDC or WHO (Reilly, 2005).

The WHO and CDC reference standards are recommended for international comparisons and secular trend analysis for overweight and obesity in children and adolescents in developing countries (de Onis, Garza, Onyango & Borghi, 2007a; Soliman et al., 2011). In the Arabian Gulf region, several studies have compared the WHO and CDC references. For example, in Qatar, Soliman et al. (2011) found that using WHO standards for infants (0-18 months) estimated more overweight and obesity in this age group compared to CDC standards. Similarly, El-Mouzan et al. (2010a) found that WHO 2007 estimates were higher for both overweight and obesity compared to CDC standards (23.9% versus 20.4%) and (9.3% versus 5.7%).

However, El-Mouzan et al. (2010b) found no significant difference (p=0.100) between the WHO and CDC cut-offs reference standards for preschool children (24-60 months) in prevalence of overweight at 5% and 5.8% respectively. This was for the WHO cut-off > +2 SD, however, when the lower BMI cut-off > + 1 SD was used there was significant (p=0.001) difference between WHO and CDC (15.7% and 12.2% respectively). Contrariwise, a study comparing WHO and IOTF (Al-Sendi et al., 2003b) found that WHO standards reported higher overweight and obesity (21% in males and 35% in females) among Bahraini adolescents (12-17 years) compared to the IOTF reference.

National references and growth charts have been established in some of the Arabian Gulf countries such as Saudi Arabia (Al-Herbish et al., 2009) and the United Arab Emirates (Abdulrazzaq, Moussa & Nagelkerke, 2008) which have also been compared with the international reference standards. El-Ghaziri et al. (2011) report several studies that showed that national reference data for BMI-for-age provide lower estimates of overweight and obesity in children and adolescents compared to WHO 2007, CDC

2000, and IOTF cut-offs. For example, a comparison study of the national Saudi growth charts 2005 (El-Mouzan, Al-Herbish, Al-Salloum, Qurachi & Al-Omar, 2007) and the American CDC reveal that using CDC charts for Saudi children and adolescents results in a downward shift from the higher CDC percentile results in overestimating overweight and obesity and an upward shift of the CDC on lower percentiles results in overestimating of under-nutrition, stunting and wasting in Saudi children and adolescents (El-Mouzan et al., 2008).

Similarly, El-Ghaziri et al. (2011) found that the prevalence of overweight and obesity among 10-14 year olds Kuwaiti adolescents using the national Kuwaiti Reference (Al-Isa, 2004) was lower (36.7%) compared to IOTF, CDC and WHO 2007 (44.7%, 44.9% and 50.5% respectively).

Therefore, since WHO standards are based on healthy populations from international background, it consequently seems to be the most suitable reference compared to CDC which is based on populations with higher prevalence of overweight and obesity (El-Mouzan et al., 2010b). The WHO Multicentre Growth Reference Study Group (2006) suggests that the WHO standards can be used worldwide, regardless of ethnicity, socioeconomic status and type of feeding. The WHO 2006 standards have been suggested to be a better monitoring tool, particularly during early infancy due to the rapid and changing rate of growth compared to CDC (de Onis et al., 2007a).

In summary, evidence suggests that using different reference standards for the classification of childhood overweight and obesity on the same datasets yields different rates. The WHO standards have been suggested to be most suitable for use among the

Arabian Gulf children and adolescents, since it is based on healthy population and from international background. In addition, it includes infants below 2 years of age.

The following section will review the prevalence of childhood overweight and obesity among children and adolescents of the Arabian Gulf states.

5. Prevalence of childhood overweight and obesity in the Arabian Gulf States

The prevalence of childhood overweight and obesity has increased significantly in the Eastern Mediterranean region in the last three decades, including the Arabian Gulf countries (Musaiger & Al-Hazzaa, 2012). The rising prevalence of childhood obesity is one of the major public health problems in the Arab Gulf countries (Musaiger & Gregory, 2000; Ng, Zaghloul, Ali, Harrison & Popkin, 2011a; Kerkadi et al., 2009). According to the IASO (2012), the highest reported prevalence of childhood overweight and obesity in the EMR was from the Arab Gulf countries. Bahrain has been reported to have the highest prevalence (42.4%) among girls based on IOTF cut-off pints (IASO, 2012). Furthermore, IASO (2013) has summarized international data for comparison purposes using the IOTF cut-off points. Figure (2) illustrates the prevalence data from the five Arabian Gulf countries (excluding Oman due to data unavailability). It is however, noteworthy that not all data are based on nationally representative studies (IASO, 2013). Furthermore, the data (Figure 2) does not include young children below 5 years.

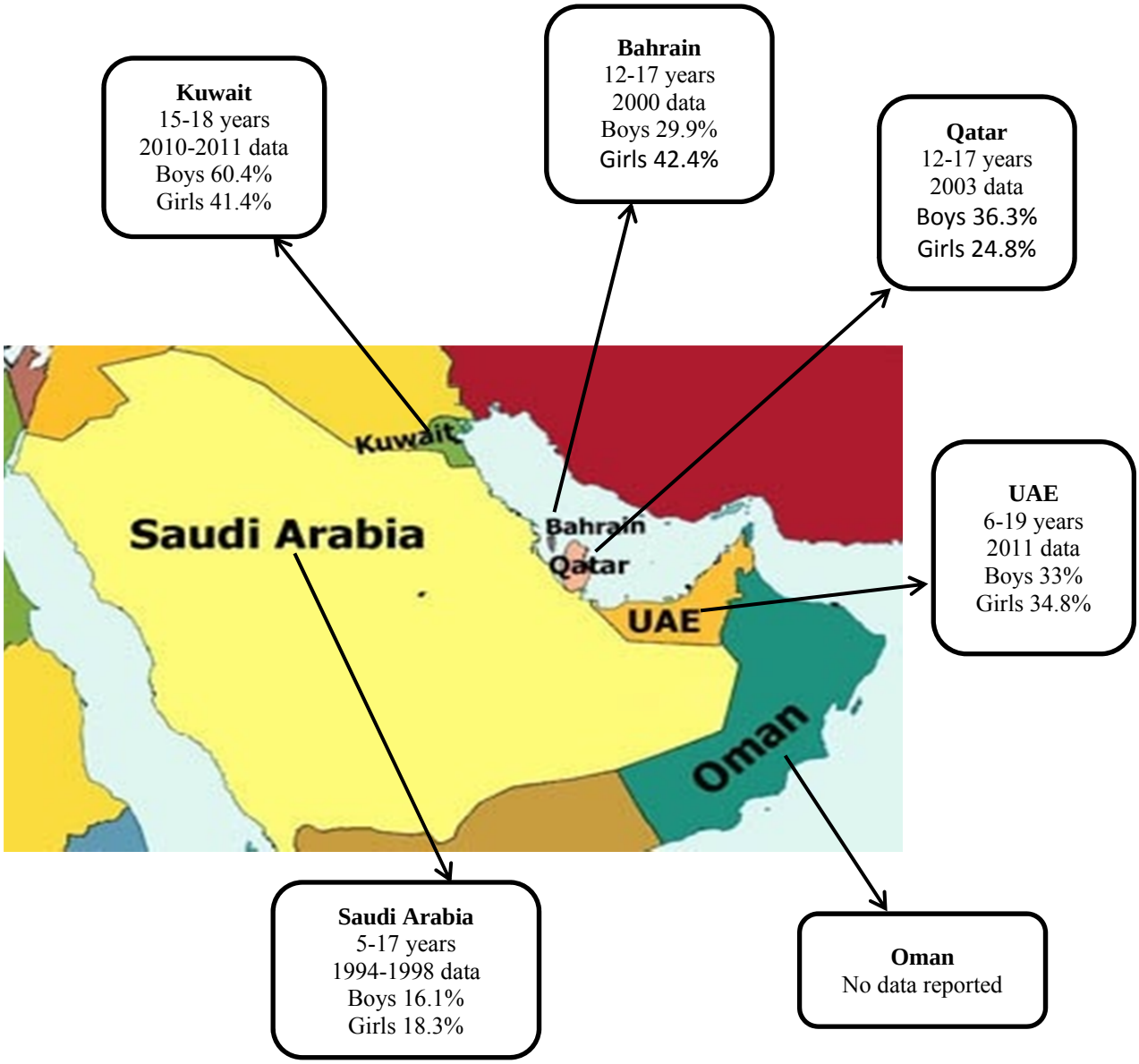

Figure 2: Prevalence of childhood obesity in the Arabian Gulf countries
Source: International Association for the Study of Obesity (2013).

For comparison purposes, it is recommended that same definition and reference to be used across countries, however, there is no one definition considered to be better than the other for this purpose (Flegal & Ogden, 2011).

Regional comparison on the prevalence of childhood overweight and obesity from published research is problematic. Table 1 provides a summary of published data. The challenge is due to the limited published national surveillance data for the Arabian Gulf countries. In addition, lack of uniformity on the cut-off reference standards used to assess childhood obesity as well as the variations on sample sizes included on each study. In table 1 attempt was made to report studies that are nationally representative or the most resent published data with large sample size.

The WHO global database on child growth and malnutrition (2013a) also reports prevalence of childhood obesity for the Arabian Gulf countries, using only national surveillance. However, data varies between countries and time of the survey. For example, for Bahrain, the reported data was of 1989 and 1995, whilst for Kuwait it was the more recent data of 2012.

Several studies have investigated the prevalence of overweight and obesity among children and adolescents of Arabian Gulf with different age group variations. The studies may be categorized according to the age groups; pre-school age, adolescents and studies that combined school-age and adolescents.

In comparison to the older children and adolescents, studies that investigated overweight and obesity among infants and preschool age are scarce. In Saudi Arabia, a national representative sample of 15,554 preschool children (0-5 years) found an overall obesity prevalence of 6% among boys and girls (El-Mouzan et al., 2010b).

Table 1 National prevalence of overweight and obesity among children and adolescents in Arabian Gulf Countries

Country	Date of survey	Sample size	Gender	Age (year)	Definition	% overweight	% Obese	Reference
Bahrain	1999-2001	2,594	M,F*	6-18	CDC**	9.1 (M) 13.5 (F)	12.3 (M) 11.9 (F)	Gharib & Rasheed (2008)
Kuwait	2006	5,402	M,F	10-14	NCHS***	30.7	14.6	El-Bayoumy, Shady & Lotfy (2009)
Oman	2009	8,105	M,F	0-5	WHO**** 2006	8.4	1.9	Alasfoor et al., 2011 (As cited in WHO, 2011)
Qatar	2003-2004	7,442	M,F	6-18	IOTF*****	24.3 (M) 18.7 (F)	6.1 (M) 3.6 (F)	Bener & Kamal (2005)
Saudi Arabia	2005	19, 317	M,F	5-18	WHO 2007	23.1	9.3	El-Mouzan et al. (2010a)
United Arab Emirate	1998-1999	16, 391	M,F	4-18	IOTF	17.1 (M) 20.1 (F)	7.7 (M) 7.1 (F)	Al-Haddad, Little & Abdul Ghafoor (2005)
	1998-1999	4381	M,F	5-17	IOTF	19.2 (M) 19.8 (F)	13.1 (M) 12.4 (F)	Malik & Bakir (2007)

*M=Male, F=Female
**CDC=Centers for Disease Control
***NCHS=National Center for Health Statistics
****WHO=World Health Organization
*****IOTF= International Obesity Task Force

Similarly, in Oman reported data based on the national study on Protein Energy Malnutrition (PEM) 1999 showed a prevalence of 1.9% overweight among 16,000 (0-5 years) infants and young children (Alasfoor & Mohammed, 2009; Ministry of Health [MOH], 2009) and 0.5% obesity (MOH, 2009) compared with 11.3% underweight. The PEM study in 2009 however, reported an increase of overweight prevalence to 8.4% and obesity 1.9% with a decrease in the prevalence of underweight to 6.3% among the same age group (Alasfoor et al., 2011 as cited in WHO, 2011).

The prevalence of overweight and obesity have also been reported to be high in school aged children between 5-19 year olds in all Arabian Gulf countries. For example, two studies (Bener & Kamal, 2005; Ng et al., 2011b) have investigated age group 6-18 years and have both used the IOTF standard cut-offs however, the sample size differed greatly between the two studies. Nevertheless, Bener and Kamal (2005) found that the prevalence of overweight and obesity in Qatar among 7,442 school children and adolescents to be 24.3% and 6.1% for boys and 18.7% and 3.6% for girls respectively. Whilst, Ng et al. (2011b) found similar pattern in a cross-sectional study of 529 Emarati children and adolescents with overweight and obesity among girls (20.5% and 19.7% respectively) and boys (16.2% and 11.7% respectively). Another study in the UAE, investigated the prevalence at a national level among children and adolescents (5-17 years) reported prevalence of overweight and obesity to be > 30% based on IOTF (Malik & Bakir, 2007). In addition, Al Junaibi et al. (2013) found that 14.2% of Emarati children and adolescents (6-19 years) were overweight and 19.8% were obese based on CDC criteria.

In Saudi Arabia conversely, a cross-sectional study in the Eastern province on 7,056 children (2-18 years) revealed a prevalence of 19.0% overweight and 23.3% obese

based on CDC (Al-Dossary et al., 2010). These findings suggest that obesity is more prevalent in Saudi children and adolescents compared to overweight, which is contrary to the worldwide recognized norms. This may be due to the geographical distribution as this study was conducted in one city in Saudi Arabia.

In Oman, data on obesity show a prevalence of (1.0%, 3.0% and 3.9%) among school children aged 6, 12, and 15 years respectively, based on the latest reported data in 2007 of annual school health examination which is reported as health statistics (MOH, 2009)

Similarly, a cohort of 550 school children aged (6, 12-13 and 15-16 years) showed that the prevalence among this group of students to be 7.3%, 16% and 23.3% respectively according to IOTF (Osman, Muscati, Ganguly, Khan & Al-Sharji, 2004).

In addition, other studies have focused mainly on adolescents aged between (10-19 years). For example, in Bahrain, the assessment of overweight among 584 adolescent girls aged (12-19 years) was high at 38.5% and obesity was 6.3% according to BMI (Musaiger, Al-Ansari & Al-Mannai, 2000). Similarly, a cross-sectional study (Al-Sendi, Shetty & Musaiger, 2003a) on 506 Bahraini adolescents (12-17 years) showed increases in BMI as well as percentage body fat.

High prevalence of overweight and obesity have also been reported in Qatar and UAE among (12-17 years) adolescents. A cross-sectional study (Bener, 2006) found that among 3,923 Qatari adolescents of whom 28.6% boys and 18.9% girls were overweight and 7.9% boys and 4.7% girls were obese.

Similarly, in Dubai the overall prevalence of overweight and obesity among adolescents was found to be 19.3% and 21.6% in boys and 12.3% and 19.5% in girls respectively based on WHO standards (Bin Zaal, Brebner, Musaiger & D'Souza, 2011).

Correspondingly to the Saudi study (Al-Dossary et al., 2010) these results are contrary to the normal expected rates showing higher obesity compared to overweight which may raise a concern in this region, since both studies were based on urban areas with rapid development and socioeconomic transformation. In addition, it is noteworthy that severe obesity (BMI > +3 SD) has not been largely reported in the Arabian Gulf region. For the purpose of this literature review, only one study was found that reported prevalence of severe obesity (BMI > +3 SD) to be 2% among 5-18 years Saudi children and adolescents according to WHO reference standards (El-Mouzan et al., 2010a).

Furthermore, the global school-based student health survey in the UAE reported 38.4% of overweight and 14.4% obese among 13-15 years (CDC, 2010). In addition, for the early ages of adolescents (10-14 years), the overall prevalence of overweight and obesity among this age group of 14,659 Kuwaiti adolescents was found high at 30.9% (Al-Isa, 2004).

In summary, evidence suggests high prevalence of childhood overweight and obesity among children and adolescents of Arabian Gulf. However, there appears to be a lack of recent national data that have investigated the prevalence of childhood overweight and obesity in some countries such as Oman.

6. Secular trends of childhood overweight and obesity in the Arabian Gulf States

Current review (Mirmiran et al., 2010) suggests that there is a rising prevalence of childhood obesity in the Gulf Countries over time. In some countries, the secular trend has been reported to have increased up to seven times. For example, in Saudi Arabia Al-Hazzaa (2007a) found that the prevalence of obesity has increased from 3.4% to 24.5%

(between 1988 and 2005 respectively). Similarly, Al-Hazzaa (2007b) found that BMI progressively increased from 9.6% to 10.8% at the 50th percentile and from 10.9% to 13.9% at the 90th percentile between 1988 and 1996 based on data from three large population-based studies among Saudi adolescents (15-19 years).

Similarly, Abalkhail (2002) found a considerable increase in BMI particularly at the 85th percentile and the 95th percentile among Saudi children and adolescents (10-20 years) based on two datasets of 1994 and 2000 showing percentage difference in BMI that ranged from 10% to 12%.

Similar trends have been reported in Bahrain and Oman. For example, Musaiger et al. (2000) found the mean weight was higher in 2000 compared to 1986 for the prevalence of overweight among Bahraini female adolescents (12-18 years). Furthermore, mean BMI in 2003 was found to be higher compared to data reported in 1986 and 1992 (Al-Sendi et al., 2003a).

In Oman, a rising trend on obesity among ages (6, 12 and 15 years) was observed between 2004-2007, with 30% increase between 2006 and 2007 according to health statistics (MOH, 2009). Similarly, Osman et al. (2004) has pointed out the problem of rising obesity in Oman.

However, contrary to the above, Abahussain (2011) reported no statistically significant change in BMI incidence of overweight and obesity during the 10 year span (1997-2007) among Saudi adolescent girls (15-18 years).

In summary, evidence suggests that there is a rising trend of overweight and obesity among children and adolescents of Arabian Gulf countries. However, results should be interpreted with caution since assessing trends in overweight and obesity may encounter

methodological constraints due to the likelihood of non-standardized measurements and equipment used (de Onis & Blössner, 2000).

7. Demographic risk factors associated with childhood overweight and obesity

Prevalence of overweight and obesity in childhood have been associated with demographic risk factors such as, gender, age, ethnicity and geographical distribution (Mirmiran, 2010). The following part will discuss the prevalence of childhood overweight and obesity by gender, age, ethnicity and geographical distribution in the Arabian Gulf countries.

7.1 Prevalence of childhood overweight and obesity by gender

In the developed countries, gender differences in the prevalence of childhood overweight and obesity are inconsistent. In the UK, for example, the mean BMI was found to be higher in girls than boys (18.6 kg/m^2 and 18.3 kg/m^2) among 2-15year olds (Mandalia, 2012). However, in the US recent data 2007-2010 showed no gender differences in overweight or obesity among children and adolescents age 2-19 years (Ogden, Carroll, Kit & Flegal, 2012).

In contrast, a review of Middle Eastern studies (Mirmiran et al., 2010) found that overweight and obesity is more prevalent in boys than girls. International comparisons also report higher prevalence among boys compared to girls in developing countries (Mirmiran et al., 2010).

However, in the Arabian Gulf countries, mixed findings were found. Several studies (Al-Isa & Thalib, 2006; Al-Dossary et al., 2010; El-Hazmi & Warsy, 2002; Al-Sendi et al., 2003a; Al-Isa, 2004) show that both overweight and obesity were more prevalent among girls compared to boys. For example, Kuwaiti adolescents girls (10-14 years)

showed higher BMI compared to boys using NCHS reference standards (Al-Isa, 2004). Similarly, Al-Isa and Thalib (2006) found that Kuwaiti girls (3-9 years) BMI at the 85th and 95th percentiles to be higher than that of boys.

Similar pattern was found in Saudi national survey of 12,701 children and adolescents (1-18 years) that the prevalence of overweight and obesity was higher in girls (12.7% and 6.74%) compare to boys (10.7% and 5.99%) using IOTF reference values (El-Hazmi & Warsy, 2002). Comparable results have also been reported in Bahrain, that mean BMI was higher in girls than boys ($p< 0.01$) across the ages 12 to15 years (Al-Sendi et al., 2003a).

Contrary to the above, in Qatar the prevalence of both overweight and obesity has been reported to be higher in boys than girls. For instance, Bener and Kamal (2005) found that more males than females were overweight or obese among 7,442 school children and adolescents (6-18 years). Similarly, in a cross-sectional study of 3,923 Qatari adolescents (12-17 years), the prevalence of both overweight and obesity were higher among boys compared to girls (28.6% versus18.9%) and (7.9% versus 4.7%) respectively according to IOTF (Bener, 2006). Furthermore, a study among (9-11 years) Qatari children found that overweight was higher among boys than girls 20.6% and 15.5% respectively (Kerkadi et al., 2009).

Consistent with the US findings (Ogden et al., 2012), in Saudi Arabia El-Mouzan et al. (2010a) found no significant difference ($p=0.507$) between boys and girls in overweight prevalence (19.9% versus 19.2%) or obese (11.2% versus 10.0%; $p=0.101$) among 5-18 year olds.

7.2 Prevalence of childhood overweight and obesity by age

There seem to be a general agreement in regard to the prevalence of childhood overweight and obesity by age. In most developed countries, prevalence of childhood obesity increases with age (Reilly, 2005). This has been linked to the greater exposure of the obesogenic environment (Reilly, 2005) which is an environment that encourages the development of obesity due to readily availability of high energy dense foods and societal changes that reduced physical activity. Older children and adolescents are more likely to be obese compared to preschool children (Ogden & Carroll, 2010). Similarly, Mandalia (2012) found that BMI increased with age among 2-15 year olds in both genders.

Studies that compared overweight and obesity among different age groups in the Middle East have also shown an increase with age progression (Mirmiran et al., 2010; Al-Isa 2004; Osman et al., 2004; Al-Hourani, Henry & Lightoweler, 2003).

In the Arabian Gulf countries, similar pattern exist. For example, the mean BMI was found to have increased with age among 6-18 years Qatari school children (Bener & Kamal, 2005). Similar findings were found in UAE (Al-Haddad, Little & Abdul Ghafoor, 2005; Malik & Bakir, 2007; Al Junaibi et al., 2013), Oman (MOH Oman, 2009) and Saudi Arabia (Al-Dossary et al., 2010). For example, Malik and Bakir (2007) found that age group 11-13 years presented the highest prevalence of both overweight and obesity compared to 5-7 year olds. Similarly, in Abu Dhabi, UAE, the prevalence of both overweight and obesity were found to be more in adolescents (11-19 years) compared to younger children 6-10 year olds (Al Junaibi et al., 2013). Furthermore, an

increase of prevalence with age at 1.0%, 3.0% and 3.9% among age 6, 12, and 15 years respectively was reported in Oman (MOH, 2009).

Furthermore, studies in Bahrain have focused mainly on adolescents and found similar pattern of progressive increase of overweight and obesity among this group of individuals. For example, Al-Sendi et al. (2003a) found that in Bahraini adolescents, the frequency of obesity was higher at age 14 years in boys and at 15 years in girls compared to age 12 and 13 years. Another study on Bahraini adolescent girls (12-19 years) showed a dramatic increase of overweight from 13.8% to 55.9% between age 12 years and 19 years (Musaiger et al., 2000).

7.3 Prevalence of childhood overweight and obesity by ethnicity

Ethnic and racial variations in the prevalence of childhood obesity have been reported in developed countries. For example, in the US significant differences in obesity prevalence by race/ethnicity were found (Ogden et al., 2012). In 2009-2010 data, results showed that 21.2% of Hispanic children and adolescents and 24.3% of non-Hispanic black children and adolescents were obese compared with only 14.0% of non-Hispanic white children and adolescents (Ogden et al., 2012). However, data on variation of ethnicity in the Arabian Gulf countries is scarce. This may be due to the fact that majority of studies in the Gulf region that investigated the prevalence of overweight and obesity had focused on national children and adolescents and excluded the non-nationals (Al-Haddad et al., 2005;Gharib & Rasheed, 2008; Bin Zaal et al., 2011;Al Junaibi et al., 2013).

Nevertheless, two studies have investigated ethnicity variations in relation to overweight and obesity in Arabian Gulf children. The first study (Malik & Bakir, 2007)

from the UAE, found that expatriate girls had the highest prevalence (38.5%) of overweight and obesity and the lowest was among Emarati boys (30%). However, study (Al-Dossary et al., 2010) from Saudi Arabia reported no significant difference in overweight (18.7% versus 20.1%) or obese (23.7% versus 21.6%) between Saudi and non-Saudi children and adolescents respectively.

7.4 Prevalence of childhood overweight and obesity by region

Regional variations have also been reported from different countries in relation to prevalence of childhood overweight and obesity (El-Mouzan et al., 2012). For example, in the US, data from the 2003 National Survey of Children's Health (Tudor-Locke, Kronenfeld, Kim, Benin & Kuby, 2007) revealed geographical variations for combined at risk of overweight and overweight between 27.2% and 46.1% among 5-17 years olds. Studies and reports (El-Mouzan et al., 2012; El-Hazmi & Warsy, 2002; Malik & Bakir, 2007) from the Arabian Gulf countries revealed similar findings. For example, in Saudi Arabia, El-Mouzan et al. (2012) found highly significant differences in the prevalence of both overweight and obesity between the Central region, the South Western region and the Northern region. The overall prevalence of overweight was 21%, 13.4% and 20.1%, whilst the prevalence of obesity was 9.3%, 6.0% and 9.1% respectively. Similarly, El-Hazmi and Warsy (2002) found that highest prevalence of overweight and obesity was in the Eastern province and the lowest in Southern province of Saudi Arabia. Furthermore, geographical variations were found between rural and urban areas of UAE, with the lowest prevalence in rural area (27.1%) compared to (34.9%) in urban area (Malik & Bakir, 2007).

In summary, mixed findings have been reported in relation to prevalence of overweight and obesity among children and adolescents of the Arabian Gulf by gender. However, there seem to be a general agreement that the prevalence of overweight and obesity increases with age in children, including the Arabian Gulf children. In addition, consistent to the West, geographic variations have been reported also in this part of the world. Ethnicity on the other hand, has not been largely investigated in the Arabian Gulf children and the reported studies yield mixed findings.

8. Conclusion

In conclusion, childhood overweight and obesity is evident and common among the Arabian Gulf children and adolescents. High prevalence has been reported to reach 42.4% among Bahraini girls and 36.3% among Qatari boys. However, international comparison of overweight and obesity prevalence is difficult due to the differences in obesity definition and cut-points criteria, differences in timing of data collection and sampling (Reilly, 2005).

There are various definitions based on BMI and recommended cut-offs reference standards such as the WHO 2006 and 2007, the IOTF and CDC which evidence suggests that they yield different rates when used on the same datasets. Despite some limitations, the BMI remains the basis for defining and classifying childhood overweight and obesity and is useful for comparisons between groups or population.

The WHO standards have been suggested to be most suitable for use among the Arabian Gulf children and adolescents, since it is based on healthier population from international background. Furthermore, it includes infants below 2 years of age compare to CDC and IOTF. However, other measurements of overweight and obesity such as

waist circumference (WC) has been recommended to be included in the assessment of childhood obesity, together with the BMI as WC is thought to correlate with body fatness particularly abdominal obesity, better than the BMI. In addition, it is a simple, inexpensive and practical measurement.

The prevalence of childhood overweight and obesity has increased significantly in the in the last three decades in the Arabian Gulf countries. Furthermore, the present review suggests a strong correlation between age group and overweight in this group of population of Arabian Gulf. The rising trend is considered to be one of the major public health problems in the Arabian Gulf. However, data that have investigated the prevalence of childhood overweight and obesity in Oman appears to be limited. Furthermore, the reported prevalence is relatively low in comparison to the other neighbouring countries. The Ministry of Health (2009) reports prevalence of (1.0%, 3.0% and 3.9%) among 6, 12, and 15 year olds respectively. Similarly, the reported national data of 2009 by the WHO global database on child growth and malnutrition (as cited in WHO, 2011) reports the obesity prevalence of 1.9%. Therefore surveillance of prevalence of childhood obesity in Oman is essential for prevention and control strategies. On this basis, the main objectives of the research were formulated as follow:

1. To investigate the prevalence of overweight and obesity among paediatric patients (0-15 years) at Sultan Qaboos University Hospital (SQUH), Oman between 2007 and 2012.
2. To examine the secular trend of overweight and obesity among paediatrics at SQUH between 2007 and 2012.

9. References

Abahussain, N. (2011). Was there a change in the body mass index of Saudi adolescent girls in Al-Khobar between 1997 and 2007. *Journal of Family and Community Medicine, 18*(2), 49-53. doi: 10.4103/2230-8229.83367

Abalkhail, B. (2002). Overweight and obesity among Saudi Arabian children and adolescents between 1994 and 2000. *Eastern Mediterranean Health Journal, 8*(4-5), 470-479. Retrieved from http://www.emro.who.int

Abdulrazzaq, Y. M., Moussa, M. A., & Nagelkerke, N. (2008). National growth charts for the United Arab Emirates. *Journal of Epidemiology,* 18(6), 295-303. doi:10.2188/jea.JE2008037

Al-Dossary, S. S. A., Sarkis, P. E., Hassan, A., Regal, M. E. E., & Fouda, A. E. (2010). Obesity in Saudi children: A dangerous reality. *Eastern Mediterranean Health Journal, 16*(9), 1003-1008. Retrieved from http://www.emro.who.int

Al-Haddad, F. H., Little, B. B., & Abdul Ghafoor, A.M. (2005). Childhood obesity in United Arab Emirates schoolchildren: A national study. *Annals of Human Biology, 32*(1), 72-72. doi:10.1080/03014460400027425

Al-Hazzaa, H.M (2007a). Prevalence and trends in obesity among school boys in Central Saudi Arabia between 1988 and 2005. *Saudi Medical Journal, 28*(10):1569-74. Retrieved from http://www.smj.org.sa

Al-Hazzaa, H. M. (2007b). Rising trends in BMI of Saudi adolescents: Evidence from three national cross sectional studies. *Asia Pacific Journal of Clinical Nutrition, 16*(3), 462-466. Retrieved from http://apjcn.nhri.org.tw

Al Herbish, A. S., El Mouzan, M. I., Al Salloum, A. A., Al Qureshi, M. M., Al Omar, A. A., Foster, P. J., & Kecojevic, T. (2009). Body mass index in Saudi Arabian children and adolescents: A national reference and comparison with international standards. *Annals of Saudi Medicine, 29*(5), 342-347. doi: 10.4103/0256-4947.55162

Al-Hourani, H. M., Henry, C. J. K., & Lightowler, H. J. (2003). Prevalence of overweight among adolescent females in the United Arab Emirates. *American Journal of Human Biology, 15*(6), 758-764. doi:10.1002/ajhb.10212

Al-Isa, A. N. (2004). Body mass index, overweight and obesity among Kuwaiti intermediate school adolescents aged 10-14 years. *European Journal of Clinical Nutrition, 58*(9), 1273-1277. doi:10.1038/sj.ejcn.1601961

Al-Isa, A.N., & Thalib, L. (2006). Body mass index of Kuwaiti children aged 3-9 years: Reference percentiles and curves. *The Journal of the Royal Society for the Promotion of Health, 126*(1), 41-46. doi:10.1177/1466424006061176

Al-Junaibi, A., Abdulle, A., Sabri, S., Hag-Ali, M., & Nagelkerke, N. (2013). The prevalence and potential determinants of obesity among school children and adolescents in Abu Dhabi, United Arab Emirates. *International Journal of Obesity, 37*, 68–74; doi:10.1038/ijo.2012.131

Al-Sendi, A. M., Shetty, P., & Musaiger, A. O. (2003a). Anthropometric and body composition indicators of Bahraini adolescents. *Annals of Human Biology, 30*(4), 367-367. doi:10.1080/0301446031000091792

Al-Sendi, A. M., Shetty, P., & Musaiger, A. O. (2003b). Prevalence of overweight and obesity among Bahraini adolescents: A comparison between three different sets of criteria. *European Journal of Clinical Nutrition, 57*(3), 471-474. doi: 10.1038/sj.ejcn.1601560

Alasfoor, D., Mohammed, A.J. (2009). Implications of the use of the new WHO growth charts on the interpretation of malnutrition and obesity in infants and young children in Oman. *Eastern Mediterranean Health Journal, 15*(4), 890-898. Retrieved from http://www.emro.who.int

Bellizzi, M. C., & Dietz, W. H. (1999). Workshop on childhood obesity: Summary of the discussion. *The American Journal of Clinical Nutrition, 70*(1), 173S-175S. Retrieved from http://ajcn.nutrition.org

Bener, A. (2006). Prevalence of obesity, overweight, and underweight in Qatari adolescents. *Food and Nutrition Bulletin, 27*(1), 39-47. Retrieved from http://www.foodandnutritionbulletin.org

Bener, A., & Kamal, A. A. (2005). Growth patterns of Qatari school children and adolescents aged 6-18 years. *Journal of Health, Population, and Nutrition, 23*(3), 250-258. Retrieved from http://www.jhpn.net

Bin Zaal, A.A., Brebner, J., Musaiger, A.O., & D'Souza, R. (2011). Anthropometric characteristics and obesity among adolescents in the United Arab Emirates. *Eastern Mediterranean Health Journal, 17*(5), 382-386. Retrieved from http://www.emro.who.int

Bray, G.A. (2011). *A guide to obesity and metabolic syndrome: Origins and treatment*. Boca Raton [FL]: CRC Press.

Centers for Disease Control and Prevention. (2012). *Basics about childhood obesity: How is childhood overweight and obesity measured?* Retrieved August 15, 2013 from http://www.cdc.gov/obesity/childhood/basics.html

Centers for Disease Control and Prevention. (2010). *Global school-based student health survey. United Arab Emirates*. Retrieved August 15, 2013 from http://www.cdc.gov/gshs/countries/eastmediter/UAE.htm

Chinn, S. (2006). Definition of childhood obesity: Current practice. *European Journal of Clinical Nutrition, 60*(10), 1189-1194. doi: 10.1038/sj.ejcn.1602436

Cole, T.J., Bellizzi, M.C., Flegal, K.M., & Dietz, W.H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *British Medical Journal, 320*(7244), 1240-1240. Retrieved from http://www.bmj.com

de Onis, M., & Blössner, M. (2000). Prevalence and trends of overweight among preschool children in developing countries. *American Journal of Clinical Nutrition, 72*(4), 1032-1039. Retrieved from http://ajcn.nutrition.org

de Onis, M., Garza, C., Onyango, A. W., & Borghi, E. (2007a). Comparison of the WHO child growth standards and the CDC 2000 growth charts. *The Journal of Nutrition, 137*(1), 144-148. Retrieved from http://jn.nutrition.org

de Onis, M., Onyango, A., Borghi, E., Siyam, A., Blössner, M., & Lutter, C. (2012). Worldwide implementation of the WHO child growth standards. *Public Health Nutrition, 15*(9), 1603-1610. doi: 10.1017/S136898001200105X

de Onis, M., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007b). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization, 85*(9), 660-667. doi:10.2471/BLT.07.043497

El-Bayoumy, I., Shady, I., & Lotfy, H. (2009). Prevalence of obesity among adolescents (10 to 14 years) in Kuwait. *Asia Pacific Journal of Public Health, 21*(2), 153-159. doi:10.1177/1010539509331786

El-Ghaziri, M., Boodai, S., Young, D., & Reilly, J. J. (2011). Impact of using national v. international definitions of underweight, overweight and obesity: An example from Kuwait. *Public Health Nutrition, 14*(11), 2074-2078. doi: 10.1017/S1368980011001285

El-Hazmi, M.A., & Warsy, A.S. (2002). The prevalence of obesity and overweight in 1-18 year old Saudi children. *Annals of Saudi Medicine, 22*(5-6), 303-307. http://www.annsaudimed.net

El Mouzan, M. I., Al Herbish, A. S., Al Salloum, A. A., Al Omar, A. A., & Qurachi, M. M. (2012). Regional variation in prevalence of overweight and obesity in Saudi children and adolescents. *Saudi Journal of Gastroenterology, 18*(2), 129. doi: 10.4103/1319-3767.93818

El Mouzan M., Al Herbish A., Al Salloum A., Foster P., Al Omar A., Qurachi M., & Kecojevic T. (2008). Comparison of the 2005 growth charts for Saudi children and adolescents to the 2000 CDC growth charts. *Annals of Saudi Medicine, 28*(5), 334-340. Retrieved from http://www.annsaudimed.net

El-Mouzan, M., Al-Herbish, A., Al-Salloum, A., Qurachi, M., & Al-Omar, A. (2007). Growth charts for Saudi children and adolescents. *Saudi Medical Journal, 28*(10), 1555-1568. Retrieved from http://www.smj.org.sa

El Mouzan, M. I., Foster, P. J., Al Herbish, A. S., Al Salloum, A. A., Al Omer, A. A., Qurachi, M. M., & Kecojevic, T. (2010a). Prevalence of overweight and obesity in Saudi children and adolescents. *Annals of Saudi Medicine, 30*(3), 203-208. doi: 10.4103/0256-4947.62833

El Mouzan, M. I., Foster, P. J., Al Herbish, A. S., Al Salloum, A. A., Al Omar, A. A., Qurachi, M. M., & Kecojevic, T. (2010b). Prevalence of overweight in preschool children using the new WHO growth standards. *E-SPEN, the European e-Journal of Clinical Nutrition and Metabolism, 5*(1), e10-e13. doi:10.1016/j.eclnm.2009.10.008

Flegal, K.M., & Ogden, C.L. (2011). Childhood obesity: Are we all speaking the same language? *Advances in Nutrition, 2*(2), 159S-166S. doi: 10.3945/an.111.000307

Freedman, D. S., & Sherry, B. (2009). The validity of BMI as an indicator of body fatness and risk among children. *Pediatrics, 124*(Suppl 1), S23-S34. doi:10.1542/peds.2008-3586E

Gharib, N.M., & Rasheed, P. (2008). Obesity among Bahraini children and adolescents: Prevalence and associated factors. *Journal of the Bahrain Medical Society, 20*(3), 114-123. Retrieved from http://www.jbmsonline.com

Gharib, N. M., & Shah, P. (2009). Anthropometry and body composition of school children in Bahrain. *Annals of Saudi Medicine, 29*(4), 258-269. doi: 10.4103/0256-4947.55309

Guillaume, M. (1999). Defining obesity in childhood: Current practice. *The American Journal of Clinical Nutrition, 70*(1), 126S-130S. Retrieved from http://ajcn.nutrition.org

International Association for the Study of Obesity (2012). *Obesity data portal: Prevalence of overweight and obesity in children by WHO Region*. Retrieved August 4, 2013 from http://www.iaso.org/resources/obesity-data-portal/resources/tables/

International Association for the Study of Obesity (2013). *Obesity data portal: Prevalence of overweight in children around the Globe*. Retrieved August 4, 2013 from http://www.iaso.org/resources/obesity-data-portal/resources/tables/

Kerkadi, A., Hassan, A.S., & Yousef, M.A.E. (2009). High prevalence of the risk of overweight and overweight among Qatari children ages 9 through 11. *Nutrition & Food Science, 39*(1), 36-45. doi:10.1108/00346650910930806

Malik, M., & Bakir, A. (2007). Prevalence of overweight and obesity among children in the United Arab Emirates. *Obesity Reviews, 8*(1), 15-20. doi:10.1111/j.1467-789X.2006.00290.x

Mandalia, D. (2012). *Health Survey for England-2011. Health, social care and lifestyles. Chapter 11: Children's BMI, overweight and obesity.* Retrieved from Health and Social Care Information Centre website http://www.hscic.gov.uk/catalogue/PUB09300

Messiah, S.E., Arheart, K.L., Natale, R.A., Hlaing, W.M., Lipshultz, S.E., & Miller, T.L. (2012). BMI, waist circumference, and selected cardiovascular disease risk factors among preschool-age children. *Obesity, 20*(9), 1942-1949. doi: 10.1038/oby.2011.353

Ministry of Health (2009). *National nutrition surveillance report. Oman*. Retrieved from www.moh.gov.om/en/reports/National_nutrition_surveillance_report.pdf

Mirmiran, P., Sherafat-Kazemzadeh, R., Jalali-Farahani, S., & Azizi, F. (2010). Childhood obesity in the Middle East: A review. *Eastern Mediterranean Health Journal, 16*(9), 1009-1017. Retrieved from http://www.emro.who.int

Monasta, L., Lobstein, T., Cole, T.J., Vignerová, J., & Cattaneo, A. (2011). Defining overweight and obesity in pre-school children: IOTF reference or WHO standard? *Obesity Reviews, 12*(4), 295-300. doi: 10.1111/j.1467-789X.2010.00748.x

Moussa, M.A.A., Alsaeid, M., Abdella, N., Refai, T.M.K., Al-Sheikh, N., & Gomez, J.E. (2008). Prevalence of type 2 diabetes mellitus among Kuwaiti children and adolescents. *Medical Principles and Practice, 17*(4), 270-275. doi: 10.1159/000129604.

Musaiger, A. O. (2011). Overweight and obesity in Eastern Mediterranean region: Prevalence and possible causes. *Journal of Obesity, 2011*(407237), 1-17. doi:10.1155/2011/407237

Musaiger A. O., Al-Ansari, M., & Al-Mannai, M. (2000). Anthropometry of adolescent girls in Bahrain, including body fat distribution. *Annals of Human Biology, 27*(5), 507-507. doi:10.1080/030144600419332

Musaiger, A. O., & Al-Hazzaa, H. M. (2012). Prevalence and risk factors associated with nutrition-related non-communicable diseases in the Eastern Mediterranean region. *International Journal of General Medicine, 5*, 199-217. Retrieved from http://www.dovepress.com

Musaiger, A. O., & Gregory, W. B. (2000). Profile of body composition of school children (6-18y) in Bahrain. *International Journal of Obesity and Related Metabolic Disorders, 24*(9), 1093-1096. doi: 10.1038/sj.ijo.0801371

Nader, P. R., O'Brien, M., Houts, R., Bradley, R., Belsky, J., Crosnoe, R., . . . National Institute of Child Health and Human Development Early Child Care Research Network. (2006). Identifying risk for obesity in early childhood. *Pediatrics, 118*(3), e594-e601. doi:10.1542/peds.2005-2801

Ng, S. W., Zaghloul, S., Ali, H. I., Harrison, G., & Popkin, B. M. (2011a). The prevalence and trends of overweight, obesity and nutrition-related non-communicable diseases in the Arabian Gulf states. *Obesity Reviews, 12*(1), 1-13. doi: 10.1111/j.1467-789X.2010.00750.x

Ng, S. W., Zaghloul, S., Ali, H., Harrison, G., Yeatts, K., El Sadig, M., & Popkin, B. M. (2011b). Nutrition transition in the United Arab Emirates. *European Journal of Clinical Nutrition, 65*(12), 1328-1337. doi:10.1038/ejcn.2011.135

Ogden, C., & Carroll, M. (2010). Prevalence of obesity among children and adolescents: United States, trends 1963-1965 through 2007-2008. Retrieved from Centers for Disease Control and Prevention website http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm

Ogden, C.L., Carroll, M.D., Kit, B.K., & Flegal. K.M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of American Medical Association, 307*(5), 483-490. doi:10.1001/jama.2012.40

Ogden, C.L., & Flegal. K.M. (2010). Changes in terminology for childhood overweight and obesity. *National Health Statistics Report, 25*, 1-8. Retrieved from Centers for Disease Control and Prevention website www.cdc.gov/nchs/data/nhsr/nhsr025.pdf

Osman, Y.F., Muscati, S.K., Ganguly, S.S., Khan, M., & Al-Sharji, B. (2004). Progression of obesity among Seeb school children in Oman. A preliminary study. *Saudi Medical Journal, 25*(12), 2038-2040. Retrieved from http://www.smj.org.sa

Punnose, J., Agarwal, M. M., El Khadir, A., Devadas, K., & Mugamer, I. T. (2002). Childhood and adolescent diabetes mellitus in Arabs residing in the United Arab

Emirates. *Diabetes Research and Clinical Practice, 55*(1), 29-33. doi: 10.1016/S0168-8227(01)00267-4

Reilly, J.J. (2005). Descriptive epidemiology and health consequences of childhood obesity. *Best Practice and Research Clinical Endocrinology and Metabolism, 19*(3), 327-341. doi:10.1016/j.beem.2005.04.002

Rolland-Cachera, M.F. (2011). Childhood obesity: Current definitions and recommendations for their use. *International Journal of Pediatric Obesity, 6*(5-6), 325-31. doi: 10.3109/17477166.2011.607458.

Rolland-Cachera, M.F. (2012). Towards a simplified definition of childhood obesity? A focus on the extended IOTF references. *Pediatric Obesity 7*(4), 259–260. doi: 10.1111/j.2047-6310.2012.00077.x

Savva, S. C., Tornaritis, M., Savva, M. E., Kourides, Y., Panagi, A., Silikiotou, N., . . . Kafatos, A. (2000). Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *International Journal of Obesity, 24*(11), 1453-1458. Retrieved from http://www.nature.com

Soliman, A., Eldabbagh, M., Khalafallah, H., Alali, M., & Elalaily, R. K. (2011). Longitudinal growth of infants in Qatar: Comparison with WHO and CDC growth standards. *Indian Pediatrics, 48*(10), 791-796. doi:10.1007/s13312-011-0123-9

Taha, D., Ahmed, O., & bin Sadiq, B. (2009). The prevalence of metabolic syndrome and cardiovascular risk factors in a group of obese Saudi children and adolescents: A hospital-based study. *Annals of Saudi Medicine, 29*(5), 357-360. doi: 10.4103/0256-4947.55164

Taylor, R.W., Jones, I.E., Williams, S.W., & Goulding, A. (2000). Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3-19 years. *The American Journal of Clinical Nutrition, 72*(2), 490-495. Retrieved from http://ajcn.nutrition.org

Tudor-Locke, C., Kronenfeld, J. J., Kim, S. S., Benin, M., & Kuby, M. (2007). A geographical comparison of prevalence of overweight school-aged children: The national survey of children's health 2003. *Pediatrics, 120*(4), e1043-e1050. doi:10.1542/peds.2007-0089

World Health Organization. (2011). *Global Database on Child Growth and Malnutrition. Oman.* Retrieved August 10, 2013 from http://www.who.int/nutgrowthdb/database/countries/omn/en/

World Health Organization. (2013a). *Global Database on Child Growth and Malnutrition*. Database. Retrieved August 10, 2013 from http://www.who.int/nutgrowthdb/database/en/

World Health Organization. (2013b). *Global Database on Child Growth and Malnutrition. Description: The Z-score or standard deviation classification system.* Retrieved from http://www.who.int/nutgrowthdb/about/introduction/en/index4.html

World Health Organization Multicentre Growth Reference Study Group (2006). WHO child growth standards based on length/height, weight and age. *Acta Paediatrica, 95*(Supplement 450), 76-76. doi:10.1080/08035320500495548

World Health Organization. (2000). *Obesity: Preventing and managing the global epidemic. Report of WHO consultation.* WHO Technical Report Series 894. Geneva, Switzerland.

RESEARCH ARTICLE

Prevalence of obesity among paediatrics (0-15 years) at Sultan Qaboos University Hospital: A retrospective chart review

Key words: Childhood overweight, BMI-for-Age, WHO standards, Oman

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Rational for Publication

The Eastern Mediterranean Health Journal (EMHJ) was selected since it is the premier public health journal of the World Health Organization (WHO) in the Eastern Mediterranean Region (EMR), including the Arabian Gulf. The journal publishes original peer-reviewed research papers on health and medical fields with particular focus on public health in the region. The current research data was based substantially on paediatric patients from the Sultan Qaboos University Hospital (SQUH), Oman. The research focused on the prevalence of childhood overweight and obesity which is considered one of the major public health problems in the region, particularly the Arabian Gulf region. The journal is freely available online which makes it more likely to be read by health professionals and those interested in the area of childhood obesity in the EMR and beyond. Speed of publication can be less than two months.

Abstract

Objectives: To investigate the prevalence of overweight and obesity among paediatric patients aged (0-15 years) at Sultan Qaboos University Hospital, SQUH between 2007 and 2012.

Design: A retrospective chart review study.

Subjects & Methods: A total of 3,657 paediatric patients 0-15 year olds who consulted the SQUH paediatric services between 2007 and 2012 were included in the analysis. Data was abstracted from the electronic medical records database. The WHO reference cut-offs BMIs (> +1 and > +2 standard deviation scores [SDS]) were used for overweight and obesity respectively.

Results: The overall prevalence of childhood overweight was (11.3%) and obesity (9.4%) in all age groups. There was no significant difference (*P*=0.564) between boys and girls. A significant increase of overweight (8.0% vs 12.4%, *P*=0.001) and obesity (4.2% vs 12.9%, *P*=0.001) was found between younger age group (3-5 years) and the older (10-15 years) age group. An increasing annual trend of obesity (6.2%, 7.8%, 9.3%, 10.5% and 11.5%) was evident (*P*=0.029) between year 2007 and 2011 respectively, with a slight decrease (9.9%) in 2012. Nevertheless, findings also suggest underweight prevalence of 14.2% among paediatric patients of which 4.5% are severely underweight.

Conclusion: The prevalence of childhood overweight and obesity is increasing among SQUH paediatrics. The present study provides useful insight for policy development to establish better monitoring system, management and prevention efforts within the SQUH. However, underweight remain a problem that equally requires further attention and intervention.

Introduction

Childhood obesity is considered one of the major public health problems in both developed and developing countries (Al-Junaibi, Abdulle, Sabri, Hag-Ali & Nagelkerke, 2013). The Middle Eastern region has been reported to demonstrate the highest prevalence of childhood obesity (de Onis & Blössner, 2000) particularly in the Arabian Gulf states (El-Ghaziri, Boodai, Young & Reilly, 2011; Al-Dossary, Sarkis, Hassan, Regal & Fouda, 2010). Data from International Association for the Study of Obesity (IASO) suggests that childhood obesity is exceptionally high in the Arabian Gulf states reaching up to 42.4% among Bahraini girls (IASO, 2012), and 36.7% among Qatari boys (IASO, 2013).

In Oman, however, the prevalence data on childhood obesity is scarce. Previous studies on Omani children had focused mostly on protein-energy malnutrition [PEM] (Alasfoor et al., 2007) since childhood obesity was not a concern prior to the oil-based transformation of the Omani economy that has occurred in the last three decades (Osman, Muscati, Ganguly, Khan & Al-Sharji, 2004).

The reported data based on the national study on PEM 1999 showed a prevalence of 1.9% overweight among 16,000 (0-5 years) Omani infants and young children (Alasfoor & Mohammed, 2009; Ministry of Health [MOH], 2009) and 0.5% obesity compared with 11.3% underweight (MOH, 2009) according to the World Health Organization (WHO) growth reference 2006. These rates are relatively low considering those reported in the neighbouring countries for the similar age group (0-5 years) such as Saudi Arabia. El-Mouzan et al. (2010b) reported an overall obesity prevalence of 6.0% among Saudi infants and preschool children.

For the older Omani children and adolescents, a cohort study of 550 school children (Osman et al., 2004) aged 6, 12-13 and 15-16 years showed the prevalence among this group of students to be 7.3%, 16% and 23.3% respectively.

However, a more recent data from school annual examination 2007 on obesity among Omani children shows substantially lower prevalence of obesity (1.0%, 3.0% and 3.9%) among age 6, 12, and 15 years respectively (MOH, 2009) compared to the data reported by Osman et al. (2004) which may be due to the difference in the sample size.

Nevertheless, overweight and obesity is considered one of the main risk factors of non-communicable diseases in the Gulf Countries (Musaiger & Al-Hazaa, 2012) with increased frequency of reported obesity-associated health consequences in children and adolescents (El-Mouzan et al., 2010a). This includes but is not limited to type 2 diabetes (Moussa et al., 2008) and metabolic syndrome (Taha, Ahmed & bin Sadiq, 2009). Furthermore, evidence suggests that overweight and obese children are likely to become obese adults (WHO, 2013). Consequently, prevalence data are essential for effective clinical interventions and strategic prevention programmes.

Therefore, in order to add valid information about the weight status and the body mass index (BMI) of children visiting the Sultan Qaboos University Hospital (SQUH), the objective of this study was to investigate the prevalence of overweight and obesity among paediatric patients aged (0-15 years) at SQUH between 2007 and 2012.

Methods

Study design

A retrospective medical record review of paediatric patients, who consulted the SQUH, between January 2007 and December 2012.

Setting

The study was conducted at the Sultan Qaboos University Hospital (SQUH), Muscat, Oman. The SQUH is one of the major tertiary hospitals in Oman, with 550 bed capacity. The hospital has three paediatric wards, Neonatal Unit, Paediatric Intensive Care Unit (PICU), Bone Marrow Transplant Unit (BMT), Accident and Emergency (A&E), and paediatric day care. In addition, there are over 20 specialized clinics that are conducted weekly excluding the Family and Community (FAMCO) clinic. The patients at SQUH are referred from all governorates of the Sultanate of Oman.

Sample

A convenience sampling method was used for this study (Figure 1), as all paediatric patients (0-15 years) who consulted SQUH paediatric clinics, day care, FAMCO, Accident and Emergency, or were admitted in one of the three paediatric wards between January 2007 and December 2012 were included.

Due to the nature of disease category, the neonatal unit, BMT unit and PICU were excluded due to less likely occurrence of overweight or obesity in patients admitted into those units. Following that, the inclusion/exclusion criteria were based on the

availability of the registered body mass (weight) in (kg), and stature (length/height) in (cm) for the most recent hospital admission or visit on the same observation date.

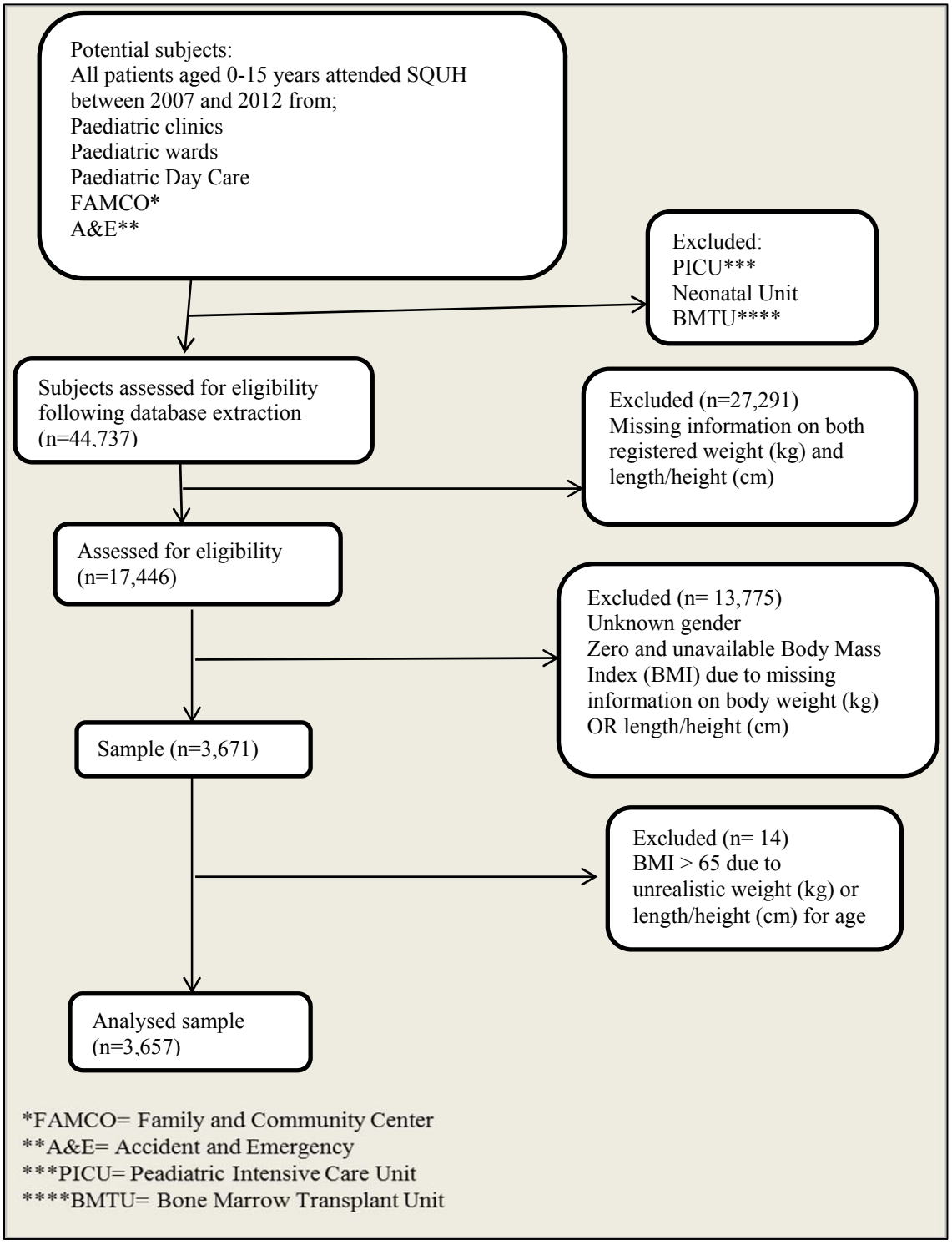

Figure1. Subjects Sampling Flowchart

The final analysed sample consisted of paediatric patients aged 0-15 years with both weight (kg) and length/height (cm) previously measured and recorded on the same observation date. Total number of paediatrics who met the criteria were (n=3,657).

Data collection

Data was abstracted from the intersystem TrakCare® database by the medical system programmer at the SQU Hospital Information System (HIS). The data was abstracted based on the standard abstraction form (Appendix 1), and abstraction protocol (Appendix 2) that were developed by the researcher prior to data collection. The tool information was limited to variables that were thought to be relevant to the research objectives based on clinical experience of the researcher.

Variables consisted of demographics such as (Gender, Age, Nationality, Area of Residence) and anthropometry information of (Weight (kg) and length/height (cm)). In addition, a calendar year between January 2007 and December 2012, patient type, date of birth, and date of observation for both weight (kg) and length/height (cm) were to be specified. The abstraction protocol was provided as well as the code and definition of each variable (Appendix 2). Validation of the abstraction form was based on the previously validated tools (Banks, 1998; Atehortua & Issa, 2012; Bennett et al., 1993) that were adopted for the current research.

Incomplete data and missing data consisted of any blank field of either weight (kg) or length/height (cm), or both.

An electronic database was used to retrieve and abstract the data since the study population was large (Worster & Haines, 2004). Bias in abstracting data was minimized

since the abstractor was not aware of the research questions. Furthermore, her background was not clinical.

The abstracted data was automated and saved in Microsoft Excel. Actual age was calculated based on the date of birth. In addition, the body mass index (BMI) kg/$(m)^2$ was calculated for all cases. The BMI-for-Age classification was based on World Health Organization (WHO, 2006; de Onis et al., 2007) standard deviation scores were estimated manually by the researcher for each patient according to the actual age, BMI and gender which was then entered into the Excel sheet. In addition, patients were categorized in age groups as (0-2, 3-5, 6-9 and 10-15 years) for analysis based on the child development categories adapted from Centers for Disease Control and Prevention (CDC, 2012).

Intra-rater reliability was determined as the abstractor repeated the data abstraction twice on the same group of records. The first data was deemed unusable due to the complicated arrangement of the weight and length/height as saved on Excel.

Inter-rater reliability was not required for this study since the required variables were objective and did not require clinical judgment (Pan, Fergusson, Schweitzer & Hebert., 2005).

Anthropometric measurements

Body mass (weight, kg) and stature (length/height, cm) for each patient were obtained from the patients' electronic medical records database. The BMI was calculated in Microsoft Excel 2010 based on the formula weight (kg)/length/height $(m)^2$. The prevalence of overweight and obesity were defined according to the World Health Organization (WHO, 2006; de Onis et al., 2007) BMI-for-Age and standard deviation

scores since it included infants < 2 years. The BMIs cut-offs (> +1 and > +2 standard deviation scores [SDS] for overweight and obesity respectively) were used for both 0-5 years and 5-19 years. In addition, the standard deviation BMI cut-off (< -2 SDS) was used to estimate the prevalence of underweight children, since it is still considered a problem in the Gulf region (Abahussain, 2011; Alasfoor et al., 2007). The rest of BMIs-for-Age in relation to SDS that fell between > -2 and < +1 SD were considered healthy.

Ethical considerations

Formal ethical approval was obtained from the Human Research Ethics Committee, College of Medicine and Health Sciences, Sultan Qaboos University prior to the research and data collection. The collected patients' data was treated with confidentiality throughout the research.

Data analysis

Data was analysed using the Statistical Package for the Social Sciences (SPSS) version 21.0. Variables were analysed using descriptive analysis with percentages and medians to describe the characteristics of demographic data and prevalence of overweight and obesity. Frequency differences between groups were analysed using Chi Squared (X^2) test for difference and Kruskal Wallis ANOVA and post hoc analysis. Statistical significance p-value ≤ 0.05 was considered for all tests.

Results

A total of 3,657 (8.2%) paediatric patients admitted or consulted SQUH clinics between January 2007 and December 2012 were included in the final analysis to estimate the prevalence of overweight and obesity among 0-15 year olds (Figure 1). Duplicate cases accounted for 16.2% (n=592) between 2007 and 2012 with repetitions between two to four times.

Appendix (3) illustrates sample characteristics and anthropometry measurements by gender. There were 2,057 boys (56.2%) and 1,600 girls (43.8%) in the total sample of which the majority of patients 3,415 (93.4%) were Omanis.

The mean age of the patients was 7.9 years (SD ±3.9). The anthropometry measurements means for length/height (cm), weight (kg) and BMI ($kg/(m)^2$) were (117.9 ±29.1, 25.4 ±14.8 and 16.6 ±4.4) respectively.

The majority of patients 74.5% (n=2,725) were consulted at SQUH paediatric clinics as out-patients compared to 25.5% (n=932) who were admitted as in-patients.

The patients' distribution by calendar year was similar between 2007 and 2010 with fewest 13.6% (n=497) in 2008, with largest number 25.3% (n=927) being in 2012. Patients' age categories distribution were highest in the age group (6-9 years) at 42.2% (n=1,543) and lowest in the age group (3-5 years) at 7.8% (n=287).

The overall prevalence of overweight in this sample of patients was 11.3% (n=415), and the overall prevalence of obese was 9.4% (n=343) (Figure 2). The prevalence of underweight was also estimated to be 14.2% (n=519) and prevalence of patient who fall at healthy category was 65.1% (n=2,380) (Figure 2).

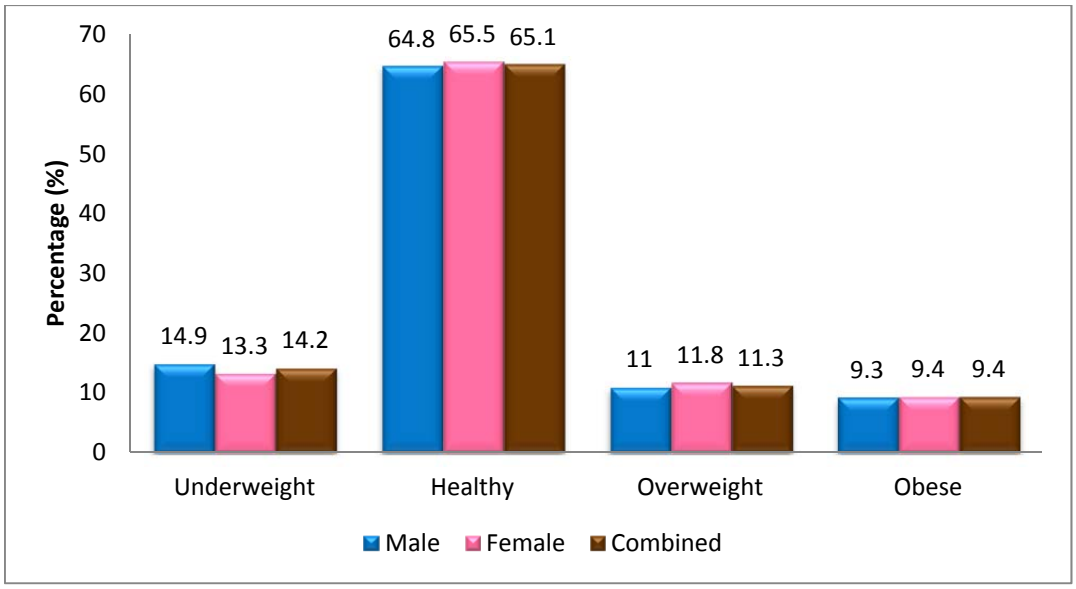

Figure 2: Prevalence of childhood underweight, overweight and obesity at SQUH

Figure (2) show no significant X^2(3, n=3657, p=0.564) gender differences in underweight, overweight or obese between boys and girls.

Age groups revealed significant difference X^2 (3, n=3657, p=0.001) between the younger and the older groups among paediatric patients at SQUH (Table 1).

Table 1. Prevalence of Childhood Underweight, Overweight and Obesity among Paediatric Patients at SQUH

Characteristics	Underweight (BMI-for-Age > 2 SD)	Overweight (BMI-for-Age > 1 SD)	Obese (BMI-for-Age > 2 SD)	P-Value
Gender (%)				
Male	14.9	11.0	9.3	0.564*
Female	13.3	11.8	9.4	
Age group (%)				
Birth-2 years	16.1	11.0	5.8	
3-5 years	15.0	8.0	4.2	0.001**
6-9 years	13.0	11.3	8.9	
10-15 years	14.5	12.4	12.9	
Nationality (%)				
Omani	14.8	10.3	8.8	0.001*
Non-Omani	6.2	26.4	16.9	
Patient Type (%)				
In-Patient	19.8	9.7	7.5	0.001*
Out- Patient	12.3	11.9	10.0	
Calendar Year (%)				
2007	13.8	10.9	6.2	
2008	14.1	9.1	7.8	
2009	13.0	10.0	9.3	
2010	13.6	13.4	10.5	0.029*
2011	13.0	11.8	11.5	
2012	16.4	12.2	9.9	

*Chi-Square (X^2)
**Kruskal Wallis
0 cells (0.0%) have expected count less than 5.

Figure 3 illustrates significant increase (p=0.001) of both overweight and obesity with age progression between age groups 3-5 years, 6-9 years, and 10-15 years. However, the younger age group 0-2 years showed higher overweight and obese (11.0% and 4.8%) compared to (8.0% and 4.2%) respectively for the (3-5 years) age group.

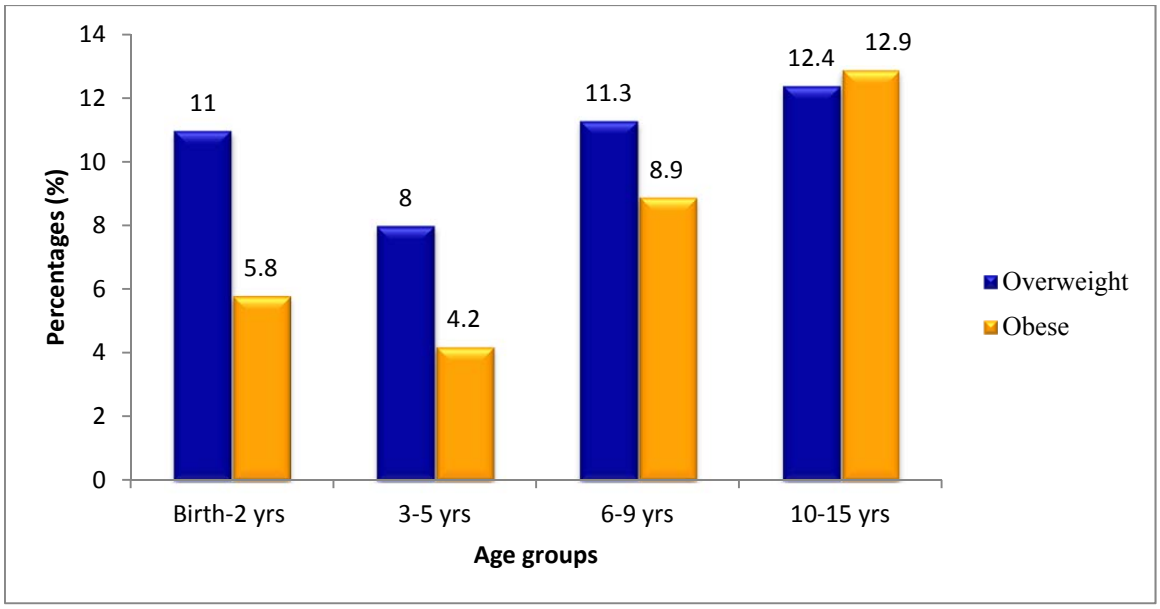

Figure 3. Prevalence of childhood overweight and obesity by age group

In regard to nationality, it is apparent from table (1) that there is significant difference in the prevalence of overweight and obesity, as well as the underweight between Omanis and non-Omanis X^2 (3, n=3657, p=0.001). The prevalence of overweight (10.3% versus 26.4%) and obesity (10.3% versus 26.4%) is lower among Omanis compared to non-Omanis respectively. However, the prevalence of underweight was higher among Omanis compared to non-Omanis (14.8% versus 6.2%) respectively.

In addition, significant difference X^2(5, n=3657, p=0.029) of overweight and obesity was found between each calendar year 2007 to 2012 (Table 1). Figure 4 illustrates

significant increasing trend in obesity between year 2007 to 2011, with a small decrease between year 2011 and 2012. The prevalence of overweight is however fluctuating with the highest (13.4%) in 2010 and lowest (9.1%) in 2008. In contrast, underweight prevalence has been relatively constant between 2007 and 2011 with slight increase in 2012 (Table 1).

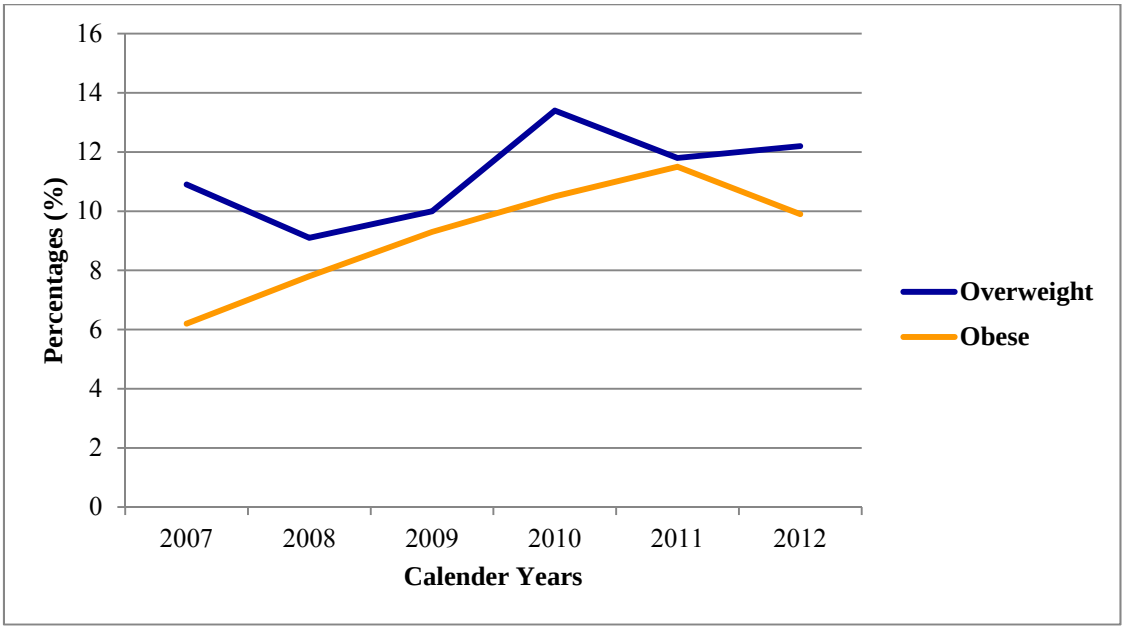

Figure 4: Prevalence of childhood overweight and obesity by calendar year

Furthermore, results show significant difference X^2 (3, n=3657, p=0.001) in the rate of underweight, overweight and obese patients between in-patients and out-patients (Table 1). Overweight and obese patients were likely to be seen as out-patients (11.9% and 10.0%) compared with in-patients (9.7% and 7.5%) respectively (Table 1).

Discussion

The present study highlights the prevalence of childhood overweight and obesity among 0-15 year paediatric patients at the SQUH. Despite the fact that this was a hospital-based study, compared to the previously reported data of childhood obesity in Oman, findings suggest a gradual increase in the prevalence of both overweight and obesity. Previous data from 1999 (MOH, 2009) suggested a prevalence of 1.9% overweight and 0.5% obesity among (0-5 year) old Omani infants and pre-school children, whereas the present study shows a prevalence of 10.0% overweight and 5.3% obese among the same age group. In comparison to the neighbouring countries, present findings are consistent with El-Mouzan et al. (2010b) who reported figures from Saudi Arabia that showed an overall obesity prevalence of 6.0% among infants and preschool children (0-5 years).

Based on WHO BMI-for-Age cut-offs, the present study found an overall prevalence of childhood overweight and obesity to be 11.3% and 9.4% respectively. By comparison, the prevalence of childhood overweight and obesity among SQUH paediatrics is considerably lower particularly the overweight than that reported in other Arabian Gulf countries using the same standard reference (WHO BMI-for-Age) cut-offs. For example, a recent study from Saudi Arabia (El-Mouzan et al., 2010a) found a prevalence of 23.1% overweight and 9.3% obese among 5-18 year olds. Similarly, El-Bayoumy, Shady and Lotfy (2009) found 30.7% of Kuwaiti children to be overweight and 14.6% to be obese. However, these variations may be due to differences in the sample characteristics including age group differences.

Gender differences in relation to overweight and obesity is debatable. The present study has not found gender differences in overweight (11.0% versus 11.8%) or obese (9.3% versus 9.4%) between boys and girls respectively. This supports the findings from Saudi Arabia (El-Mouzan et al., 2010a) as well as the USA (Ogden et al., 2012). However, the majority of reported studies in the Arabian Gulf region contained mixed findings and the pattern appear to be related to the country. For example, in Kuwait (Al-Isa, 2004; Al-Isa & Thalib, 2006) and Saudi Arabia (Al-Dossary et al., 2010) found higher prevalence of overweight and obesity among girls compared to boys, whereas in Qatar (Bener & Kamal, 2005; Bener, 2006; Kerkadi et al., 2009) boys were found to be more overweight and obese compared to girls.

In regard to the age, there appear to be a general agreement that older children are more likely to be overweight or obese compared with the younger children. The majority of studies examining the prevalence of childhood overweight and obesity between younger children to adolescents found significant increase with age progression (Bener & Kamal, 2005; Al Junaibi et al., 2013; Al-Dossary et al., 2010). The findings of the present study are consistent with the above, as a steady increase of both overweight and obesity was found from age group (3-5 years) to (10-15 years). Despite that the reasons have not been investigated in the present study, the phenomenon has been previously attributed to the obesogenic environment (Reilly, 2005) that older children and adolescent are exposed to compared with the younger children. Furthermore, Osman et al. (2004) postulated that children under normal conditions increase in height during puberty and consequence reduce in BMI. However this has not been the case in this sample which suggests an unhealthy trend of increased obesity with age.

In contrast, the prevalence of overweight and obesity among infants (0-2 years) showed higher prevalence (11.0% and 5.8%) compared with (8.0% and 4.2%) for the age group (3-5 years) group. This result could be explained by reasons not investigated in the present study, including but not limited to the feeding practices (El-Mouzan et al., 2010b).

By examining the six years trend, the present study shows a rising incidence of obesity between 2007 and 2011 (Figure 4). This is consistent with Abalkhail (2002) who has investigated the trend between the years 1994 and 2000 in Saudi Arabia. The rising trend of childhood overweight and obesity has been attributed to the rapid economy and social transformation, including nutrition-transition in a short period of about 40 years that occurred in the Arabian Gulf region (Ng et al., 2011), including Oman (Al Riyami et al., 2012). Interestingly, the rising trend of overweight and obesity in this study over the six years proportionally mimics the reducing trend in the healthy BMI-for-age category. This phenomenon suggests the shifting of children' healthy BMI towards unhealthy overweight and obesity, whereas the underweight rates remain substantially stable over the six years (Table 1). However, the prevalence of obesity showed a slight reduction between year 2011 and 2012 (Figure 4). This may be due to the larger sample (25.3%) in 2012 which may reflect the increased number of clinics that had occurred at SQUH in 2012.

Despite the fact that the main objective of the present study was to investigate the prevalence of overweight and obesity, the overall level of underweight was also found to be substantially high at 14.2% of which 4.5% were severely underweight among SQUH paediatric patients. In spite of the reported decrease according to the national PEM study in Oman that underweight among infants and young children (0-5 years)

have declined between 1980s and 1999 from 62.9% to 18% respectively (Alasfoor et al., 2007; MOH, 2009) and the proportion of underweight among older children and adolescents (6-15 years) has also been reduced from 16.5% in 2002 to 10.8% in 2007 according to the annual health statistic report (MOH, 2009).This study however, showed underweight prevalence of 15.8% among age group (0-5 year) olds and 13.7% among (6-15 years) children and adolescents. Similarly, underweight was reported to be 8.3% among children and adolescents (6-19 years) in Abu Dhabi, UAE (Al Junaibi et al., 2013) and in Qatar, the prevalence of underweight was found to be 8.6% and 5.8% among adolescent boys and girls respectively (Bener, 2006). This may confirm the general agreement that underweight is still a concern for some of Arabian Gulf countries and is considered as a major health problem (Abahussain, 2011). In Oman the prevalence of underweight in children is still considered a major public health problem, although it has improved in the last three decades, it is still high compared to health and economic indicators (Alasfoor et al., 2007).

However, it is necessary to interpret the present results with caution since the current data is hospital-based, in which cause and effect of underweight was beyond the scope of this study.

Ethnic and racial variations in the prevalence of childhood obesity have been reported in the US (Ogden et al., 2012). In this concept, the present study found lower prevalence of childhood overweight and obesity among Omanis compared with non-Omanis. This is consistent with the findings from UAE (Malik & Bakir, 2007) that found expatriate girls had the highest prevalence (38.5%) of overweight and obesity compared to Emarati girls. However, study from Saudi Arabia (Al-Dossary et al., 2010) reported no statistically significant difference between Saudi and no-Saudi children and adolescents.

In contrast, the prevalence of underweight was found to be higher among Omanis compared to non-Omanis. The possible explanation of this is complex, however, the difference could be related to genetic contribution. In addition, the hospital-based sample may explain the reason for the prevalence of underweight due to ill health among this group of patients, factors that have not been investigated in this study.

There were several limitations to this study that need to be considered. The retrospective study design is not as strong as prospective study design in clinical settings. As a retrospective chart review study, the abstracted information was limited to what was documented in the electronic medical records. This includes all the missing data which highly depended on nursing staff documentation. Consequently, the final analysed sample was only 8.2% (n=3657). Another limitation of this study is the use of convenience sample which usually limits the ability to generalize the results. However, the convenience sample provided no sampling bias since all recorded electronic files in the database were included following the inclusion criteria. Furthermore, the abstractor was not from a clinical background and did not know the study objectives in details.

Therefore, due to the present study limitations as well as the fact that the sample was hospital-based, findings are to be interpreted with caution and should not be generalized to the general population of children and adolescents in Oman. In addition, statistical significance should be interpreted with caution as it does not always indicate clinical significance especially, when measures such as BMI-for-Age is used to classify overweight and obesity, which was the case in this group of paediatrics, with all criticism that BMI stands, such as the inability to measure body fat.

Despite limitations, the present study provides data that address the prevalence of childhood overweight and obesity, as well as underweight among SQUH paediatrics using the WHO standard references. However, a prospective longitudinal national surveillance is needed to determine and fully understand the prevalence of childhood obesity in Omani children. Due to BMI limitations, a waist circumference should be included together with the BMI to further enhance our understanding of childhood obesity (Al-Hazzaa, Musaiger & ATLS research group, 2011) as it has proved to be a better predictor of cardiovascular diseases risk factor than the BMI (Savva et al., 2000).

Recent statistics in Oman have indicated high prevalence of non-communicable diseases as a consequence of obesity (Al Riyami et al., 2012). Since it is evident that childhood obesity is a risk factor for obesity in adulthood (WHO, 2013) and the fact that it is difficult to reduce weight once established therefore, it is essential to focus on prevention since early age (Al-Dossary et al., 2010) particularly in countries characterized by young population such as Oman. Of total population in Oman, (58%) are under the age of 25 years (Central Intelligence Agency [CIA], 2013). Furthermore, information on causes that are potentially contributing to the excessive weight gain among this group of population is required for strategic intervention plans.

At an organizational level, further investigation to examine health consequences related to childhood obesity among current sample of SQUH paediatrics is recommended. This will assist in the obesity management plans. In addition, further investigation to determine common locations that had the most missing data of body mass (kg) and length/height (cm) is recommended for policy review.

Conclusion

In summary, the present study provides a broad idea of the prevalence of overweight and obesity, as well as underweight among the paediatrics at SQUH. Despite the observation, that the prevalence is low compared with the neighbouring countries, the present study shows a steady increase in the prevalence of obesity between 2007 and 2011 but not overweight.

Nevertheless, research on the prevalence of overweight and obesity in childhood is crucial to identify those at risk of becoming obese adults and to establish a national strategic plan on childhood overweight and obesity prevention and control, to facilitate early interventions in this group of population. Therefore, there is an urgent need for the prospective national surveillance to investigate the prevalence of childhood overweight and obesity in Oman in order to establish national registry for childhood obesity.

Furthermore, the present study may assist policy development to establish better monitoring system, management and prevention efforts at the SQUH.

Despite that, results are not comparable to the neighbouring Arabian Gulf countries, findings urge urgent intervention programme to prevent and control obesity in this age group in Oman, as well as underweight and severe underweight. Strategic intervention programme should be considered early in childhood due to public health importance, which may prove especially important in Oman where 58% of population are under the age of 25 years (CIA, 2013).

References

Abahussain, N. (2011). Was there a change in the body mass index of Saudi adolescent girls in Al-Khobar between 1997 and 2007. *Journal of Family and Community Medicine, 18*(2), 49-53. doi: 10.4103/2230-8229.83367

Abalkhail, B. (2002). Overweight and obesity among Saudi Arabian children and adolescents between 1994 and 2000. *Eastern Mediterranean Health Journal, 8*(4-5), 470-479. Retrieved from http://www.emro.who.int

Al Riyami, A., Elaty, M. A. A., Morsi, M., Al Kharusi, H., Al Shukaily, W., & Jaju, S. (2012). Oman world health survey: Part 1 - methodology, sociodemographic profile and epidemiology of non-communicable diseases in Oman. *Oman Medical Journal, 27*(5), 425-443. Retrieved from http://www.omjournal.org

Al-Dossary, S. S. A., Sarkis, P. E., Hassan, A., Regal, M. E. E., & Fouda, A. E. (2010). Obesity in Saudi children: A dangerous reality. *Eastern Mediterranean Health Journal, 16*(9), 1003-1008. Retrieved from http://www.emro.who.int

Al-Hazzaa, H. M., Musaiger, A. O., & ATLS Research Group. (2011). Arab teens lifestyle study (ATLS): Objectives, design, methodology and implications. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 4*, 417-426. doi:10.2147/DMSO.S26676

Al-Isa, A. N. (2004). Body mass index, overweight and obesity among Kuwaiti intermediate school adolescents aged 10-14 years. *European Journal of Clinical Nutrition, 58*(9), 1273-1277. doi:10.1038/sj.ejcn.1601961

Al-Isa, A.N., & Thalib, L. (2006). Body mass index of Kuwaiti children aged 3-9 years: Reference percentiles and curves. *The Journal of the Royal Society for the Promotion of Health, 126*(1), 41-46. doi:10.1177/1466424006061176

Al-Junaibi, A., Abdulle, A., Sabri, S., Hag-Ali, M., & Nagelkerke, N. (2013). The prevalence and potential determinants of obesity among school children and adolescents in Abu Dhabi, United Arab Emirates. *International Journal of Obesity, 37*, 68–74; doi:10.1038/ijo.2012.131

Alasfoor, D., Elsayed, M.K., Al-Qasmi, A.M., Malankar, P., Sheth, M., & Prakash, N. (2007). Protein-energy malnutrition among preschool children in Oman: Results of a national survey. *Eastern Mediterranean Health Journal, 13*(5), 1022-1030. Retrieved from http://www.emro.who.int

Alasfoor, D., Mohammed, A.J. (2009). Implications of the use of the new WHO growth charts on the interpretation of malnutrition and obesity in infants and young children in Oman. *Eastern Mediterranean Health Journal, 15*(4), 890-898. Retrieved from http://www.emro.who.int

Atehortua, N.A., & Issa, A.M. (2012). A method to measure clinical practice patterns of breast cancer genomic diagnostics in health systems. *Personalized Medicine, 9*(6), 585-592. Retrieved from www.medscape.com

Banks, N. J. (1998). Designing medical record abstraction forms. *International Journal for Quality in Health Care, 10*(2), 163-167. Retrieved from http://intqhc.oxfordjournals.org

Bener, A. (2006). Prevalence of obesity, overweight, and underweight in Qatari adolescents. *Food and Nutrition Bulletin, 27*(1), 39-47. Retrieved from http://www.foodandnutritionbulletin.org

Bener, A., & Kamal, A. A. (2005). Growth patterns of Qatari school children and adolescents aged 6-18 years. *Journal of Health, Population, and Nutrition, 23*(3), 250-258. Retrieved from http://www.jhpn.net

Bennett, C., Roth, C.P., Iqbal, A., George, W.L., Rodrique, D., Sherwood, M.J., Gilman, S.C., & Shapiro, M. (1993). *Medical record abstraction form and guidelines for assessing quality of care for hospitalized patients with AIDS-related pneumocystis carinii pneumonia.* Retrieved from RAND Corporation website http://www.rand.org

Centers for Disease Control and Prevention. (2012). *Child Development.* Retrieved September 20, 2013 from http://www.cdc.gov/ncbddd/childdevelopment/positiveparenting/index.html

Central Intelligence Agency (2013). *The world factbook*. Retrieved September 14, 2013 from https://www.cia.gov/library/publications/the-world-factbook/geos/mu.html

de Onis, M., & Blössner, M. (2000). Prevalence and trends of overweight among preschool children in developing countries. *American Journal of Clinical Nutrition, 72*(4), 1032-1039. Retrieved from http://ajcn.nutrition.org

de Onis, M., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization, 85*(9), 660-667. doi:10.2471/BLT.07.043497

El-Bayoumy, I., Shady, I., & Lotfy, H. (2009). Prevalence of obesity among adolescents (10 to 14 years) in Kuwait. *Asia Pacific Journal of Public Health, 21*(2), 153-159. doi:10.1177/1010539509331786

El-Ghaziri, M., Boodai, S., Young, D., & Reilly, J. J. (2011). Impact of using national v. international definitions of underweight, overweight and obesity: An example from Kuwait. *Public Health Nutrition, 14*(11), 2074-2078. doi: 10.1017/S1368980011001285

El Mouzan, M. I., Foster, P. J., Al Herbish, A. S., Al Salloum, A. A., Al Omer, A. A., Qurachi, M. M., & Kecojevic, T. (2010a). Prevalence of overweight and obesity in Saudi children and adolescents. *Annals of Saudi Medicine, 30*(3), 203-208. doi: 10.4103/0256-4947.62833

El Mouzan, M. I., Foster, P. J., Al Herbish, A. S., Al Salloum, A. A., Al Omar, A. A., Qurachi, M. M., & Kecojevic, T. (2010b). Prevalence of overweight in preschool children using the new WHO growth standards. *The European e-Journal of Clinical Nutrition and Metabolism, 5*(1), e10-e13. doi:10.1016/j.eclnm.2009.10.008

International Association for the Study of Obesity (2012). *Obesity data portal: Prevalence of overweight and obesity in children by WHO Region*. Retrieved August 4, 2013 from http://www.iaso.org/resources/obesity-data-portal/resources/tables/

International Association for the Study of Obesity (2013). *Obesity data portal: Prevalence of overweight in children around the Globe*. Retrieved August 4, 2013 from http://www.iaso.org/resources/obesity-data-portal/resources/tables/

Kerkadi, A., Hassan, A.S., & Yousef, M.A.E. (2009). High prevalence of the risk of overweight and overweight among Qatari children ages 9 through 11. *Nutrition & Food Science, 39*(1), 36-45. doi:10.1108/00346650910930806

Malik, M., & Bakir, A. (2007). Prevalence of overweight and obesity among children in the United Arab Emirates. *Obesity Reviews, 8*(1), 15-20. doi:10.1111/j.1467-789X.2006.00290.x

Ministry of Health (2009). *National nutrition surveillance report, Oman*. Retrieved from http://www.moh.gov.om/en/nv_menu.php?o=reports/report.htm

Moussa, M.A.A., Alsaeid, M., Abdella, N., Refai, T.M.K., Al-Sheikh, N., & Gomez, J.E. (2008). Prevalence of type 2 diabetes mellitus among Kuwaiti children and adolescents. *Medical Principles and Practice, 17*(4), 270-275. doi: 10.1159/000129604.

Musaiger, A. O., & Al-Hazzaa, H. M. (2012). Prevalence and risk factors associated with nutrition-related non-communicable diseases in the Eastern Mediterranean region. *International Journal of General Medicine, 5*, 199-217. Retrieved from http://www.dovepress.com

Ng, S. W., Zaghloul, S., Ali, H., Harrison, G., Yeatts, K., El Sadig, M., & Popkin, B. M. (2011b). Nutrition transition in the United Arab Emirates. *European Journal of Clinical Nutrition, 65*(12), 1328-1337. doi:10.1038/ejcn.2011.135

Ogden, C.L., Carroll, M.D., Kit, B.K., & Flegal. K.M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of American Medical Association, 307*(5), 483-490. doi:10.1001/jama.2012.40

Osman, Y.F., Muscati, S.K., Ganguly, S.S., Khan, M., & Al-Sharji, B. (2004). Progression of obesity among Seeb school children in Oman. A preliminary study. *Saudi Medical Journal, 25*(12), 2038-2040. Retrieved from http://www.smj.org.sa

Pan, L., Fergusson, D., Schweitzer, I., & Hebert, P. C. (2005). Ensuring high accuracy of data abstracted from patient charts: The use of a standardized medical record as a training tool. *Journal of Clinical Epidemiology, 58*(9), 918-923. doi: 10.1016/j.jclinepi.2005.02.004

Reilly, J.J. (2005). Descriptive epidemiology and health consequences of childhood obesity. *Best Practice and Research Clinical Endocrinology and Metabolism, 19*(3), 327-341. doi:10.1016/j.beem.2005.04.002

Savva, S. C., Tornaritis, M., Savva, M. E., Kourides, Y., Panagi, A., Silikiotou, N., . . . Kafatos, A. (2000). Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *International Journal of Obesity and Related Metabolic Disorders, 24*(11), 1453-1458. doi:10.1038/sj.ijo.0801401

Taha, D., Ahmed, O., & bin Sadiq, B. (2009). The prevalence of metabolic syndrome and cardiovascular risk factors in a group of obese Saudi children and adolescents: A hospital-based study. *Annals of Saudi Medicine, 29*(5), 357-360. doi: 10.4103/0256-4947.55164

World Health Organization. (2013). *Global strategy on diet, physical activity and health. Childhood overweight and obesity*. Retrieved August 10, 2013 from http://www.who.int/dietphysicalactivity/childhood/en/

World Health Organization Multicentre Growth Reference Study Group (2006). WHO child growth standards based on length/height, weight and age. *Acta Paediatrica, 95*(Supplement 450), 76-76. doi:10.1080/08035320500495548

Worster, A., & Haines, T. (2004). Advanced statistics: Understanding medical record review (MRR) studies. *Academic Emergency Medicine, 11*(2), 187-192. doi: 10.1111/j.1553-2712.2004.tb01433.x

Appendix 1

Medical Record Abstraction Form

- Date of abstraction_____
- Calendar year (EXCLUDE any entry < 2007 or > 2012)

□ 2007 □ 2009 □ 2011

□ 2008 □ 2010 □ 2012

			Code
1	Type of admission (**Within Calendar Year)**	□ In-patient □ Out-patient □ In-patient + Out-patient	1 = in=patient 2 = out-patient 3= In-patient + Out-patient
	Demographics		
2	Patient's identification (MRN)	----------	
3	Gender (***Select ONLY one by entering corresponding number***)	□ Male □ Female	1= Male 2= Female
4	Date of Birth (DD/MM/YYYY)	--/--/----	9= Not available
5	Region of Residency (***Select ONLY one by entering corresponding number***)	□ Muscat □ Al-Batina □ A'Sharqiyah □ A'Dakhiliyah □ Al-Wustah □ Al-Buraymi □ Dhofar □ A'Dhahirah □ Musandam	1= Muscat 2 = Al-Batina 3= A'Sharqiyah 4= A'Dakhiliyah 5= Al-Wustah 6= Al-Buraymi 7= Dhofar 8= A'Dhahirah 9=Musandam
6	Ethnicity	□ Omani □ Non-Omani	1=Omani 2=Non-Omani
	Anthropometry (*Most Resent*)		
7	Weight Date of examination (DD/MM/YYYY)	----------kg --/--/----	9= Not available
8	Length/Height Date of examination (DD/MM/YYYY)	----------cm --/--/----	9= Not available

Appendix 2

Medical Record Data Abstraction Protocol

Variable	Definition	Best source
1. Calendar year	The year patient was seen in the hospital	Admission and discharge notes
2. Type of admission (Within Calendar Year)	Type of patients visit to the hospital, either in-patient or out-patient	TrackCare main page
3. Patient's identification code	Each patient will be assign an ID code as 0number/calendar year	Example: 01/07 0R 034/09
Demographics		
4. Patient's identification (MRN)	Hospital medical record number	On all medical record pages
5. Gender	Self explanatory	On all medical record pages Patient demographic pages
6. Date of Birth (DD/MM/YYYY)	Self explanatory	On all medical record pages
7. Region of Residency	Patients' home address	Patient demographic pages
8. Ethnicity	Identified and recorded ethnicity by the patient and/or family	Patient demographic pages
Anthropometry		
9. Weight	Patient's body weight measured in kg	
10. Date of examination (DD/MM/YYYY)	Date of which the weight was measured and recorded	Physical examination and vital signs page or EPR (Electronic Patient Record) page
11. Length/Height	Patient's length or height measured by cm	
12. Date of examination (DD/MM/YYYY)	Date of which the length or height was measured and recorded	

Appendix 3. Demographic Characteristics of Subjects by Gender

Variables	Boys (n=2057) 56.2%	Girls (n=1600) 43.8%	Both (n= 3657) 100%
Age (years) Mean (±SD)	7.9 (3.9)	7.7 (4.0)	7.8 (3.9)
Length/Height (cm) Mean (±SD)	118.9 (28.5)	116.7 (29.9)	117.9 (29.1)
Weight (kg) Mean (±SD)	25.5 (14.3)	25.3 (15.4)	25.4 (14.8)
BMI (kg/(m)^2 Mean (±SD)	16.6 (4.4)	16.7 (4.4)	16.6 (4.4)
BMI-for-Age SD (n (%))			
< -2	306 (8.4)	213 (5.8)	519 (14.2)
>-2 to < +1	1332 (36.4)	1048 (28.7)	2380 (65.1)
> +1	227 (6.2)	188 (5.1)	415 (11.3)
> +2	192 (5.3)	151 (4.1)	343 (9.4)
Age group (n (%))			
Birth-2 years	313 (8.6)	288 (7.9)	601 (16.4)
3-5 years	160 (4.4)	127 (3.5)	287 (7.8)
6-9 years	878 (24.0)	665 (18.2)	1543 (42.2)
10-15 years	706 (19.3)	520 (14.2)	1226 (33.5)
Nationality (n (%))			
Omani	1927 (52.7)	1488 (40.7)	3415 (93.4)
Non-Omani	130 (3.6)	112 (3.1)	242 (6.6)
Patient Type (n (%))			
In-Patient	518 (14.2)	414 (11.3)	932 (25.5)
Out-Patient	1539 (42.1)	1186 (32.4)	2725 (74.5)
Calendar Year (%)			
2007	289 (7.9)	227 (6.2)	616 (14.1)
2008	270 (7.4)	227 (6.2)	497 (13.6)
2009	314 (8.6)	226 (6.2)	540 (14.8)
2010	314 (8.6)	209 (5.7)	523 (14.3)
2011	365 (10.0)	289 (7.9)	654 (17.9)
2012	505 (13.8)	422 (11.5)	927 (25.3)